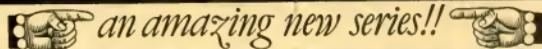
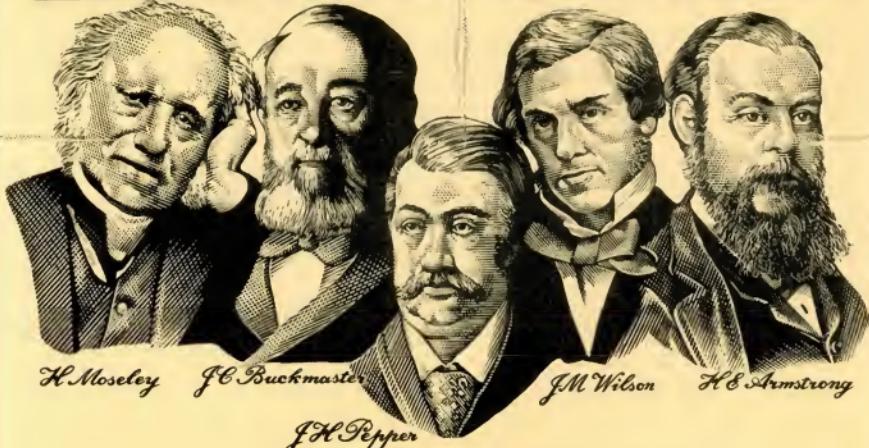


newscientist

THE FOUNDING FATHERS OF SCIENCE EDUCATION

 an amazing new series!!



H. Moseley

J.C. Buckmaster

J.H. Pepper

J.M. Wilson

H.E. Armstrong

HENRY MOSELEY

First scientist to be honoured as one of Her Majesty's Inspectors

JOHN CHARLES BUCKMASTER

A bastard from Bucks who gave science to the working people

JOHN HENRY PEPPER

Showman of science, thrilling his audience with burning phosphorus

JAMES MAURICE WILSON

The inspiring Manxman who gave us ornithopachynsipaedia

HENRY EDWARD ARMSTRONG

Pioneer of do-it-yourself chemistry

'AnalalR' Standards for Laboratory Chemicals

The registered trade name 'AnalalR', first used in 1934 to designate analytical reagents conforming to published specifications and of British origin, is now recognised internationally as being synonymous with purity and reliability.

'AnalalR Standards for Laboratory Chemicals' published by Analalr Standards Ltd is regarded as the definitive work on analytical reagents and methods of test.

The new edition, the seventh, describes in detail the tests applied to some 340 reagents and the specification to which each guaranteed 'AnalalR' product must conform.

Reflecting the recent advances in analytical chemistry, the volume is an invaluable reference and can only be obtained from the licencees of Analalr Standards Ltd.

225mm x 150mm, case bound in plastic 652pp

UK - £11.25 (incl. p & p) Code no 57008 2X Export - £11.25 (p & p extra) Code no 57008 3P



BDH Chemicals Ltd Poole BH12 4NN

Vol 75 No 1064 11 August 1977

King's Reach Tower,
Stamford Street, London SE1 9LS
Subscription inquiries: 01-634 4148
General inquiries: 01-261 5382
Cables: Verditure SEI
Telex: 915748 MAGDIV G

Editor
Dr Bernard Dixon
Deputy Editor (Science)
Dr Peter Stubbs

Deputy Editor (Technology)
Nicholas Valdary
Managing Editor
Richard Fifield

News Editor
Michael Kenward
Science Editor
Dr Roger Lewin
Science News Editor
Dr Robert Walgate

Technology News Editor
John Stansell
Social Editor
Ian Low

Feedback Editor
Dr Joseph Hanlon

Health and safety
Lawrence McGinty
Art Editor

Tom Reynolds

Assistant Art Editor
Chris Jones
Artists

Neil Hyslop, Michael Peyton
US Office
Dr Karen
205 East 42nd Street,
New York, NY 10017
Consultants

Biochemistry
Dr Robert Freedman

Environment and development
Jon Tinker

Development biology
Dr Brigid Hogan

Education

John Delin

Aerospace

Mark Hewish

Marine

Tony Loftas

Psychology

Dr Nick Humphrey

Solid state

Dr Dick Taylor

Soviet Science

Dr Sarah White

Animal behaviour

Dr Jeremy Cherfas

Advisory Panel

Sir Monty Finniston FRS

Dr Basil Mason FRS

Professor Sir Michael Swann FRS

Advertisement manager

Steven Goldsmith 01-261 5657

Advertisement production

Tim Hartney 01-261 5951

Classified Advertisements

01-261 5731

PUBLISHED WEEKLY Publisher's subscription rate, Inland: £20.70, Overseas surface mail: £22.90 (Not applicable to US and Canada), US and Canada (airfreight) \$53.00, airmail (anywhere), £38.30, Back numbers (cash with order) 55p including postage from Post Sales Dept, IPC Magazines Ltd, Lavington House, Lavington St, London SE1 9LS, registered at The Post Office as a newspaper and printed in England. 2nd class postage paid at Jamaica NY 11431. Airfreight and mailing in the USA by Publications Expediting Service, 105 W 45th St, New York, NY 10036. © IPC Magazines Ltd 1977.

OVERSEAS ADVERTISEMENTS REPRESENTATIVES: USA - Wm. Coughlin & Co., Cleveland, Ohio; Michael McLaughlin, Media Force International; The Mart Building, 68 Olive Street, Chagrin Falls, Ohio 44022. Tel: (216) 247-5200 (call collect). East Coast: Bill Strube & Mike Coughlin, Strube Coughlin Associates Inc/Media Force International, 230 Park Avenue, New York NY 10017. Tel: (212) 686-7642 Telex NY 424-294. Mid West, William E. Jacobs, 13 Hawthorne Road, Barrington, IL 60010. Tel: (312) 381-3770. Cable: Wiljay Barrington IL. Tel: 91010-252-2407.

CANADA Clement Dick, Chimney Copse RR No 1, Churchill, Ontario, Canada. Tel: (705) 456-2341. JAPAN International Media Representatives Ltd, 1 Shiba Koishikicho, Minato-ku, Tokyo, Japan. Tel: 502-0656. Telex: 22633. EUROPE Advertisements Department, New Science Publications, King's Reach Tower, Stamford Street, London, SE1 9LS. Tel: 01-261 5000. Telex: 915748 MAGDIV LDN. Cables: Verditure New Scien SEI.

Letters

Grimbleton Down

Puzzle

Ariadne

This One

WAC4-125-KJYS



This week we publish the first article in a new series which looks at the origin and development of science education (see p 363)

Cover illustration: Bill Sanderson

338 Comment

Ian Low on the government's flirtation with Official Secrets/
David Meiklejohn on Thorn's long-life bulb

339 This week

Lead in drinking water/Science and the CIA

Dan Greenberg

Let the sun shine in
US enlightenment over freedom of information

346 Tunguska: the final answer

Fresh studies reinstate the comet theory

Ian Ridpath

The case against lead in petrol
A new call for tougher regulations

John Mathews

351 Monitor

Communal triggers for hormones/Meteoritics at Cambridge

354 Technology

Microwave landing: UK challenges US/Fat years from the winged bean?

358 Feedback

Ask a tree when the train is coming

360 Geneticist at large

In Person of Walter Bodmer

Sally Festing

363 Founding fathers of science education (I)

The Benjamin of studies
How 19th century science education developed from variegated origins

David Layton

366 Review

370 Forum

With John Hillaby, Peter Laurie, Brian Inglis,
Tam Dalyell MP, Dan Greenberg and Anthony Renton

374 Letters

374 Grimbleton Down

375 Puzzle

392 Ariadne



Comment

A toe in the water

The Prime Minister's cautious advance towards open government will fail to satisfy journalists. The guidelines issued last week to 51 Permanent Secretaries and departmental heads in Whitehall require that, when a policy has been decided on and announced in Parliament, the options prepared for ministers in the later stages of deliberation, along with the factual bases of such options, will be made public. But part of the dossier will still stay under wraps, including civil service advice, comments from other ministers and items of commercial information.

This twitch of the Whitehall curtain—departments are expected to reply "positively and sympathetically" to questions from MPs, the public, journalists and research scholars—is already being seen by pessimists as a precursor to an actual tightening of the Official Secrets Act.

The biggest obstacle in the path of those who wish to see a greater measure of disclosure of information is the low esteem in which most of the British press is held. The general readership would perhaps support even greater restriction on what is seen as intrusiveness upon personal privacy. Bedevilled financially many newspapers are content to give people what they would like to know rather than what they ought to know. (Nor is it sufficient to argue that radio and television could fill the gap. The Royal Commission on the Press recently re-iterated the need for printed records of events.)

This arrangement tends to endorse the view (expressed in Sunday's "Grass Roots" radio programme) that the public is uninterested as well as incapable of comprehending, leaving the bureaucrats free to operate inside the high walls of confidentiality. One has only to compare the reporting of Watergate with the meagre accounts of British parliamentary misdoings to appreciate the advantages of a written Constitution such as the United States has. Dan Greenberg (p 344) shows that the Public Information Act, now beginning to bear fruit, is firmly rooted in the First Amendment. Last week's revelations of the involvement of medical scientists in the CIA nightmare have been possible only because of the leverage of the new act.

What is needed in the first place is the separation (for safekeeping) of the relatively few secrets vital to the country's security from those other "confidentialities" which a democratic society has a right to know. A useful model for such a reform of the legislation is contained in a pamphlet published by the Outer Circle Policy Unit. Entitled *An Official Information Act* it is the work of a new group calling itself Public Secrets. The main thrust of the pamphlet is to establish in law the principle of public access, by right, to official information, taking out of government and civil service hands the power to make available or withhold information. Such an Official Information Act would, of course, leave government "with adequate means to protect that information which ought to remain secret".

Thus the model act contained in the pamphlet excludes from the general right of access defence; foreign relations and internal security; law enforcement; Cabinet documents; information which should be privileged against compulsory disclosure in litigation; information entrusted to government by a private individual in confidence, or required of individuals by government; information entrusted to government in confidence or required by government of enterprises where disclosures would seriously affect their competitive position.

Otherwise government departments would be compelled to sort out their information and to set up channels by which public access could be assured. Cases of refusal to disclose information would be investigated by an Information Commissioner who would report to parliament.

In cases of alleged breaches of the Act (and the Attorney General's permission would be required for prosecution) the Crown would have to establish, among other things, that disclosure was contrary to public interest and had done sufficient damage to warrant criminal punishment.

The Prime Minister's step of last week does nothing in the way of inverting the tendency to withhold rather than to disclose. In the end it will require the force of law to be brought to bear. If, for one reason or another, the present Labour administration fails to fulfil its promise in the 1974 manifesto "to replace the Official Secrets Act by a measure to put the burden on public authorities to justify withholding information", the Conservatives, at present the most likely successors, ought to include freedom of information among the criteria of democracy they so frequently proclaim.

Ian Low

A fig for long life!

Recent press reports suggest that the lamp industry is taking steps to defend itself against allegations (*New Scientist*, vol 74, p 519) that it practices planned obsolescence. Thorn Lighting is to extend its Mazda range of light bulbs by bringing in a double-life bulb lasting 2000 hours. As both Philips and Crompton have been marketing such bulbs on a limited scale for some years—ever since the Monopolies Commission told them to, in fact—this may not seem very important. But Thorn is to feature its double-life bulb in a £200 000 TV advertising campaign to be launched on 24 October. Promotion on such a scale is certainly new, and must have some significance considering that the success of this bulb would put half the industry out of work.

The whole matter is easily explained. Double-life bulbs use a slightly longer filament which runs at a lower temperature and evaporates at half the rate. They cost only 1 per cent more to make, but are 8 per cent less efficient. This reduction in efficiency has an important effect on running costs, and would at least superficially appear to justify restricting life to 1000 hours. Thorn would very much like to make this publicly known—especially as the Select Committee on Science and Technology will be looking into the question of lamp life when Parliament reassembles on 26 October—and its advertising campaign will allow it to do so. Nobody, of course, could possibly object to this educational project, but Thorn also intends recouping its expenses by charging a record-breaking 30 per cent extra for the new bulb. It is to be hoped the company will not allow people to think that this difference in price has anything to do with the difference in life.

For some reason Thorn does not display the same rapacity towards its competitors. To avoid a misleadingly low efficiency, the company is employing a coiled-coil filament in its new bulb, and not the obsolete, less efficient single-coil filament which Philips and Crompton employ in their double-life bulbs to limit their market penetration. However, Thorn does not seem prepared to point out that its double-life bulb is more efficient than theirs, although it would certainly make even more money if it did. The company would be wise to do so if it wishes to maintain that the industry is competitive.

David Meiklejohn

This week

How hazardous is lead in drinking water?

The drinking water of almost two million homes in Britain contains more lead than proposed European standards would allow. In the case of almost 800 000 homes, the amount of lead in drinking water could exceed even the less strict World Health Organisation (WHO) recommendations, which UK water authorities regard as guidelines. Yet the Department of the Environment report that reveals these facts (*Lead in Drinking Water*) says that they show "no reason to think that there is any general problem of chronic lead poisoning arising from ingestion of water from public supplies".

British representatives have displayed implacable hostility to the proposed European standard in EEC discussions. So Environment Secretary Peter Shore was probably happy to see the draft directive containing the suggested lead limit "suspended" by the Council of Ministers at its meeting in June because agreement could not be reached on other clauses. So far, there is no suggestion that the Belgians, currently holding the presidency of the council, will put the draft back on the agenda. But Shore, and the water authorities, can hardly be pleased by increasing international pressure for tighter controls on lead in drinking water.

As if to deliberately embarrass Shore's department, the US National Academy of Sciences recently published a report, *Drinking Water and Health*, which recommends a safety limit twice as stringent as the EEC proposal and four times as harsh as WHO recommends.

The DoE report not only gives estimates of the concentration of lead in drinking water (derived from the most comprehensive sample survey yet mounted), but also outlines the government's scientific arguments against the proposed EEC standard. International standards on lead in drinking water have a complex history. In 1962, WHO

reduced its recommended standard from 0.1 milligramme of lead/litre to 0.05 mg/l, only to return to the 0.1 mg/l standard in 1972. The following year, the increase was attacked by a WHO working group on the health hazards of persistent substances in water and by the authoritative WHO/Food and Agriculture Organisation Expert Committee on Food Additives. (WHO also recommends that, in Europe, no water should contain more than 0.3 mg/l after standing in lead pipes for 16 hours—a standard exceeded by an estimated 160 000 UK households.) This opposition to the 1971 increase lies behind the EEC proposal of a 0.05 mg/l standard.

The core of the British argument against the proposal is that "what matters medically is the total amount of lead absorbed from all sources". The DoE report says that total dietary intake of lead, on average, is "less than half the 3 mg/person/week regarded as a provisional tolerable maximum intake" by FAO/WHO. Absorption of lead from the atmosphere is, the report claims, "usually minor". Because neither of these sources of lead are increasing, and because both are claimed to be well within international standards, there is "no immediate need for a stricter universal standard in relation to water".

The NAS report, however, comes to different conclusions, highlighting gaps in the DoE's thinking. First, the DoE uses an average figure as an estimate of lead intake from food—1 mg/l. More realistically, the NAS quotes a range (0.7-2.1 mg/week) which recognises that critical groups may eat much more than the average. Secondly, NAS disagrees with the DoE's assertion that absorption of atmospheric lead is "minor". (Indeed this statement is disproved by the DoE's own figures.) Because 35-40 per cent of atmospheric lead is absorbed into the body, as opposed to only 10 per cent of lead in food and water, lead absorbed

from the atmosphere is, the NAS report says, "comparable with the dietary absorption". Third, the DoE ignores the fact that children are a special case because two and three year olds absorb four or five times as much lead from food as adults and their water intake is greater.

The NAS committee concludes: "The sum of the estimated absorptions from the various sources, 50-60 microgrammes/day, is already at the maximum no-observed-adverse-health-effect value." It recommends that this level for lead in water "cannot be set with assurance at any value greater than 0.025 mg/l".

The cost of meeting the proposed European standard may well have been more important in forming the DoE's opposition than any scientific argument. Lead in drinking water comes almost entirely from domestic plumbing containing lead. There is little chance of meeting the EEC standard by chemically treating water so that it does not dissolve lead from pipes and storage tanks. A confidential Water Research Centre report on the problem says: "the only way of ensuring compliance . . . would be complete removal and replacement of lead pipes and lead-lined tanks".

This strategy, applied to the 10 million or so houses estimated to have lead plumbing, could cost as much as £1000 million. And because water lead levels vary from day to day, identifying houses whose plumbing needed replacing would be difficult. It could well be more effective, and cheaper, to reduce overall lead intake by dramatically reducing lead in petrol. (See this issue, p 348.)

Physicists for Orlov

One of the main talking points outside the conference rooms of the Protvino/Serpukhov accelerator conference held in the USSR last month was the fate of Professor Yuri Orlov. Orlov, a Soviet accelerator physicist, was well known to the conference participants for his important work on the Yerevan electron synchrotron in Armenia; but he was not at the conference. He was arrested in February: his crime has been to be an active dissident and founder of the Moscow group set up to monitor Soviet observance of the Helsinki agreement on human rights.

Among the material circulating at the conference was a letter from Academician Sakharov and four fellow physicists and mathematicians. This drew attention to the fact that Orlov faces a three-year prison term for "dissemination of

slanderous fabrications" and that other members of the Helsinki group are also in prison, either awaiting trial or already sentenced (in one case to 10 years in prison plus five years' exile).

There were around 100 foreign scientists at the conference and nearly all of them signed a letter of support for Orlov, which was passed on to his wife.

The case did not come up at the formal scientific sessions. Those leading Soviet scientists who were willing to talk about Orlov's plight apparently believe that campaigning on individual cases is not the best way to improve human rights in the Soviet Union. They thought that long-term, close, and continuing cooperation between the USSR and the West was more likely to change Soviet society than dramatic intervention on behalf of individuals.



"We're at our best in a crisis."

This week

continued

Scientists back CIA behaviour control

Truth drugs and projects called Artichoke and Midnight Climax sound like the stuff of B-movies and cheap spy novels. In fact, they were part of a 25-year \$25 million research programme into mind and behaviour control conducted by the US Central Intelligence Agency.

Eighty institutions, including 44 colleges and universities and several other US government agencies, were involved in the programme. Scientists tested drugs on hundreds of unsuspecting people. At least two died in the tests, and several were seriously enough affected to require hospitalisation. Undoubtedly the most grisly study was a test of a "knockout drug" conducted on advanced cancer patients.

Information on the programmes comes from thousands of pages of documents released by the CIA after a two-year legal battle under the US Freedom of Information Act waged by John Marks, co-author of *The CIA and the Cult of Intelligence*. Other information was released last week by the new CIA director Admiral Stanfels Turner in evidence to the US Senate committee on intelligence, and in a series of investigative articles in *The New York Times*.

The behaviour modification programmes ran from the late 1940s until 1973. They involved not only drugs, but also electric shock, radiation, ultrasonics, psychosurgery, psychiatry, anthropology, sociology, "harassment substances", and paramilitary devices and materials."

The first decade of research appears not to have been very successful. One report notes that "as of 1960 no effective knockout pill was known to exist. [Similarly, no] truth serum, aphrodisiac, or recruitment pill was known to exist." Nor was there more success later.

The first search was for a drug that would permit interrogators to "elicit wilfully suppressed information". A 1951 report said that experiments had already shown the potential of "pentothal sodium, marihuana, scopolamine, morphine, ether, mescaline, and probably lysergic acid." Ethyl alcohol, benzodiazepine, sodium amytal, and hypnosis had also been tried.

In the pilot study volunteers attempted to retain "experimental secrets". Later it was proposed that the drugs should "be critically tested under 'field' conditions" on prisoners of war, federal prisoners, and security officers "under threat conditions beyond the scope of civilian experimentation." LSD and a marijuanna derivative were tested on 142 "sexual psychopaths" at a hospital for the criminally insane at Iona, Michigan. Explains a CIA report: "It is thought these individuals have the kind of motivation for withholding certain information that is comparable to operational interrogation situations in the field."

LSD studies were conducted on a wide variety of people, particularly mental

patients, hospital staff, and prisoners. Tests were conducted at McGill University, Montreal; Butler Health Center, Providence, Rhode Island; Mount Sinai Hospital, New York; and the Massachusetts Mental Health Center, Boston. A chairman of the university department of psychiatry and neurology, whose name was not revealed, tested a "schizophrenic agent", bucbocapine, on prisoners. He was to study losses of speech, pain sensitivity, memory, and will power.

The Artichoke programme of the early 1950s appears at least partly aimed at the CIA's own staff. An attempt was made to find some way to produce amnesia for information about CIA operations—"for instance, after the individual had left the agency." Recent books by ex-CIA agents suggest this research project failed.

By 1953, the US Department of Agriculture had set up two labs especially for Artichoke work and "had been enlisted to speed up the bringing in to the United States various botanicals for the Artichoke program." Further, the US Food and Drug Administration had promised full cooperation with Artichoke. The CIA also set up and controlled the Society for the Investigation of Human Ecology to fund behaviour control research, and channelled funds through at least two other foundations.

The CIA also gave \$375 000 towards the construction of a hospital building at the Georgetown University Medical School. This was part of a plan to set up an entire university department of forensic medicine, endowed and staffed by the CIA. "The project and allied agency needs could thus be served with complete control, legal performances, and

appropriate cover."

For nearly a decade, the US Bureau of Narcotics supplied both informers and "members of suspect criminal elements" for drug tests. According to the CIA, "the Bureau has obtained results of operational values through the tests." Flats in New York and San Francisco, known as "safe houses", were set up with two way mirrors and concealed recording equipment. Unsuspecting men were then lured into the flats for LSD tests.

By 1963, however, the CIA had become very nervous about using people supplied by the Bureau of Narcotics. "In a number of instances," reads one report, "the test subject has become ill for hours or days, including hospitalisation in at least one case, and the agent could only follow-up by guarded inquiry after the test subject's return to normal life."

Furthermore, there is the danger that "a test subject may on some occasion in the future attribute the cause of his reaction and secure independent professional medical assistance in identifying the exact nature of the substances involved and by whom." The report admits that "no effective cover story appears to be available" and that it would be necessary to request "cooperation from local authorities in suppressing information."

Another difficulty was that "research in the manipulation of human behaviour is considered by many authorities in medicine and related fields to be professionally unethical, therefore the reputations of professional participants in the ... program are on occasion in jeopardy." The report admitted that even some people within the CIA found the programme "distasteful and unethical". □

Sex, psychics, and secret slaughter

Sex, ways of dissolving the Berlin wall, and a pill to sober up drunks were all studied by the CIA. Psychics also came under CIA scrutiny; but long before the Geller controversy the agency called in a professional magician, John Mulholland, to debunk them. Mulholland was also paid \$3000 to write a manual on sleight-of-hand to aid agents in surreptitiously administering drugs.

Ways of causing death that cannot be detected are the subject of a 1949 letter which was one of the documents released. The names of both sender and recipient were deleted by the CIA before release. The methods range from simply smothering the victim with a pillow to exposing him or her to excessive whole-body X-rays. Two techniques were particularly recommended. "Sodium fluoroacetate, when ingested in sufficient quantities to cause death does not cause characteristic pathologic lesions nor does it increase the amount of fluorine in the body to such a degree that it can be detected by quantitative methods. The other chemical substance I have in mind is tetraethyl lead, which, as you know,



"Wait a minute—I thought this was the sexual behaviour study."

could be dropped on the skin in very small quantities, producing no local lesion, and after a quick death no specific pathologic evidences of the tetraethyl lead would be present." □

Changes in Britain's patent law

Britain's new Patent Act will have far-reaching effects on British inventors and the country's industry when it comes into force next June. Delays at HM Stationery Office have held up publication of the new act, which received Royal Assent at the end of the last Parliamentary session, so there has been little publicity or comment on the new patent law.

The new law comes into effect on the same day that the European Patent Office opens for business in Munich. The coincidence is intentional because one objective of the British act is to enable UK and European patent laws to coexist and for the two patent offices to operate simultaneously—contrary to reports in the UK press there is no intention to close down the London Patent Office.

Some provisions remain from the original House of Lords Bill while others were dropped or drastically modified as the bill made its way through Parliament. As planned a new Patents Court, with specialist High Court judges, will settle disputes between inventors and the Patent Office, replacing the Tribunal of lower status that now decides such matters. Disputes between employers and employees over entitlement to an invention will also be resolved more easily and often in favour of the employee, with provision for a claim to compensate an employee whose invention is deemed to belong to his employer.

The proposal that some grounds for challenging an existing patent should be dropped has been abandoned. This would have created danger—for instance, under the new act, a manufacturer who had previously felt safe in ignoring a "bad" patent could have found that the patent was no longer open to attack. Under the new law "contributory" infringement will be actionable. This will mean, for example, that a wholesaler or retailer seeking to steer round a patent by selling an unmade kit of parts for home assembly will no longer be safe if the assembled article infringes a patent. As the law stands only the customer would be liable in most cases. And in future the sale of a die or mould to make an infringing article will also be an infringement.

In the interests of European conformity, from next June the life of a British patent will be 20 years. The provision that any current British patent with more than five years left to run will be automatically extended by four years will inevitably create anomalies—for instance, where related patents fall either side of the qualifying date. Also the pharmaceutical industry is still lobbying for a special dispensation to compensate for the time lost at the beginning of a drug patent's life while it is tested for safety. The act could still be amended to grant the automatic four-year extension to any pharmaceutical patent with more than two years left to run; but this will then

raise the tricky question of what constitutes a pharmaceutical patent. Should the term, for instance, cover nutrients, pesticides, and fertilisers? To the drug industry's general relief, however, Section 41 of the existing act, which enables third parties to demand compulsory licences to enable them to exploit drug patents, has already been repealed.

After next June provisional specifications, which carry only a £1 official fee, will no longer exist. But the new act makes provision for all new applications to be filed in simple form effectively similar to a provisional patent. Although the fee will rise from the current £1 "loss leader" level, it should be under £10. This perpetuates a unique point of British patent law; freedom for an impoverished inventor to establish a priority date for a new idea without incurring initial heavy expenses. The subsequent procedure is quite new, however. Once the initial application has been filed it can either form the basis of another similar application containing developments but claiming rights from the date of the first application; or be furnished with claims in the manner of a current complete specification. The applicant then requests and pays for a novelty search. Although the fees payable for this are not yet fixed, it is officially hoped that these will not be significantly higher than at present, even though the search and examination will be stricter than before in the UK.

The Patent Office Examiner will be free to search for any prior art, both British and foreign, and there is no 50-year rule—this now enables someone to repatent

an invention patented and then forgotten half a century ago. The examiner will also be able to argue and refuse a patent on the grounds that what is freshly claimed represents no real inventive advance over something similar that has been previously known.

A high proportion of the 750 patents now accepted each week by the Patent Office will no longer be acceptable. It will also come as a shock for some sectors of research and industry to find that any secret in their patent applications are, under the new law, laid open to the public just 18 months after the first patent filing date. For foreign inventions this may be six months after the first filing in the UK.

The full significance of the as yet unresolved issue of British and European fees is also largely unappreciated. Any large firm which normally files its patents in several European countries will, after next June, gain financially by filing a single European application. But this gain occurs only at the application stage because once the European patent is granted the applicant will have to pay annual renewal fees in each country where the patent is to apply. If national application and renewal fees are low enough, small firms wishing to save money will be able to stick with a couple of national patents. So if national fees are too low the European scheme will have less chance of success. A fine balance will thus have to be drawn between British and European fees, with the inevitable inference that British fees will reflect European rates. *Adrian Hope*

The danger of flying is not what it's cracked up to be

Anxious airline passengers who might soon be going somewhere in a Trident 3 aircraft may gain some comfort from knowing that the "foot long" hairline cracks in metal plates in the wings, a source of much media attention last week, could have been considerably longer and still not have reduced the strength of the structure nor adversely affected the 'plane's safety.

Contrary to some reports, the cracks were discovered as a result of routine testing. British Airways' engineers performing a regular major overhaul on one of its 25 Trident 3's noticed fuel seepage. Hawker Siddeley, the aircraft's maker advised further investigation involving ultrasonic testing and X-ray inspection methods, which revealed the hairline cracks. These were discovered in butt straps—pieces of metal inside the wing which overlap adjacent sections of the skin. Fuel seepage was present because the Trident, like most modern jet aircraft, uses the hollow wing spaces as fuel tanks.

BA passed these details to Hawker Siddeley which had one of the airline's Tridents at its Hatfield plant for studies into the problems of extending the aircraft's lives from 20 000 to 30 000 flights.

These faults have so far been positively identified on 10 of the Tridents and the

remainder are receiving daily checks while continuing normal service. In the meantime BA and HS engineers have been working on modifications to prevent existing cracks worsening, or their appearance on so-far unaffected planes. The favourite remedy seems to be the addition of an external butt strap to spread the load from the two skin sections. When the modification is confirmed, BA's fleet of Trident 3's will be fitted with the extra plate.

Reaction to discovery of the cracks from aviation risk expert Jim Bannister was that all aircraft suffer them. It was good news, he said that we were reading about their discovery and not that an aircraft had crashed, and this indicated the very high order of safety of commercial airline flying. Statistics showed that a businessman making 10 trips a year on scheduled service and covering 60 000 miles has an expectancy of being on board an aircraft when a fatal accident occurred once in 38 000 years.

Increased safety, in turn, has resulted from practices such as routine testing and planned replacement of components after set intervals rather than at the end of their lives. More is now learnt about aircraft design, he said, from routine testing than from post-crash inspection. □



This week

continued

A miner of information

Ian Breach, Whitehaven

Completion of the case for British Nuclear Fuels Limited (BNFL) to construct a thermal-oxide reprocessing plant (THORP) at Windscale was deferred to make room for witnesses appearing on behalf of the Society for Environmental Improvement (SEI) and the Isle of Man government: their respective submissions were interposed for most of the eighth week of the public inquiry. The audience swelled, not surprisingly, for the arrival of Arthur Scargill, leader of the 66 000-strong Yorkshire branch of the National Union of Mineworkers. When a politically uncompromising representative of the labour movement aligns himself with the antinuclear petitioners, it is then clearly a matter of considerable public interest.

Add to this the occasioning of a brief but boisterous airing of the differences between Scargill and West Cumbrian trade unionists, who turned up to tell him of their support for the THORP plant and to point out the dangers of coal mining, and it is easy to see why his visit attracted so much before-and-after attention.

What Scargill had to say, as an SEI witness, will have a significance in the inquiry record quite separate from the brouhaha that surrounded his appearance. The Yorkshire miners are sponsors and co-founders of Energy 2000, the organisation committed to the development of non-nuclear energy strategies; and Scargill—the group's current chairman—told the inquiry that he was not in Whitehaven to plead a special case for the colliers or their industry. In the long term, he believed that even coal

A critical friend

If there was a sensation in the eighth week of the inquiry, it was not the confrontation between the lads of the Barnsley coalfield and their brothers at Windscale. It was the evidence given on behalf of the Isle of Man Government by Dr Vaughan T. Bowen, an American geochemist and one of the world's most distinguished authorities on aquatic pollution. In it, he alleged that research into radioactive contamination of the Irish Sea was inadequate and misleading. He charged the Fisheries Radiobiological Laboratory at Lowestoft (run by the Ministry of Agriculture, Fisheries and Food) with "defending Windscale and related operations, rather than examining them with care".

The verbal flogging of FRL methodologists and BNFL's acceptance of them came all the more remarkably from a soft-spoken *emine grise* whose qualifications and publications are of a kind that normally signals great diplomacy. But here he was, declaring that FRL reports "have consistently suffered from failure to ask 'why, where, or how?'".

It was scientific rigour Dr Bowen was challenging—not nuclear power, of which he is a friend. Today, he is a

would no longer be used and that solar and other "benign" energy sources could provide all the power requirements for the United Kingdom. Before that—in the period between 1980 and the end of the century—he prosecuted the case for a mining programme that would take production of coal to some 250 million tonnes a year by the end of the century, or more than double the present output. With new fields, new pits, and new methods such as telepherics (remote control) mining, the man-shift output could be at least trebled.

According to Scargill's projections, the UK's electrical-energy requirements—522 million tonnes coal-equivalent (mtce) in the year 2000, which assumes

Early in the inquiry Justice Parker made it plain that he wanted to hear a detailed case put forward by the proponents of low-impact energy options. Accordingly, he displayed much interest in the submissions introduced last week by John Tyme, who is acting as the lay advocate for the Society for Environmental Improvement (SEI). One of his witnesses was Professor David Hall of the biology department at King's College London, who gave evidence on research into harnessing biological systems for the production of liquid, solid, and gaseous fuels.

Assuming a photosynthetic efficiency of only two per cent, "biomass" plantations could, Hall said, yield all the required liquid fuels from 17 per cent of the UK land area, and all the gas from 15 per cent. Sugar beet would, he

senior scientist at the Woods Hole Oceanographic Institution, Massachusetts. He was a chemist on the Manhattan Project, which led to the development of the first atomic bomb, and later played a part in the choice of Windscale as a site for the world's first nuclear power station—Calder Hall. After having reviewed all the relevant information and tested marine samples sent from the IoM to his laboratory, he now believed Windscale to be "ill chosen" for the THORP plant. Some of the FRL data used by BNFL was "utterly uninformative", and he called for a new, independent, research and monitoring effort which, he added, "would profit greatly by being located on or near the Irish Sea".

Dr Bowen was addressing himself essentially to questions of accuracy and approach—points that appeared to escape the Inspector, who clearly thought the allegations were alarmist. Words were frequently and surprisingly exchanged at cross-purposes during Justice Parker's questioning of the evidence. But the criticisms of FRL will have to be answered not by BNFL but by FRL itself.

a 2 per cent annual growth rate in consumption—could be met wholly without nuclear power in the following way:

Coal	250 million tonnes
Oil	120 mtce
Gas	100 mtce
Solar	25 mtce
Hydropower	2 mtce
Wind, wave, tidal, and geothermal	25 mtce

Deducting an estimated 50 mtce for energy savings due to improved insulation and allowing for a new-works investment figure of £45 per annual tonne of coal produced, the total cost of the Scargill programme works out—on paper—at an incredible £150 million—less than two years' nuclear research and development costs.

The alternative case

thought, be ideal for liquid-fuel production.

Stephen Salter of Edinburgh University outlined current work on wave-power systems; and Dr Peter Musgrave, from Reading University, told the inquiry about wind generators. Salter gave a firm date—1984—for installation of the first large wave-powered generating station in Britain. This would consist of an array one-km long of 50 "ducks", which would bob up and down $2\frac{1}{2}$ km off the coast of North-east Scotland. Driving hydraulic swash-plate generators, each duck would have a mean output of 30MW. The choice of site—between Scrabster and Strathy Point—is an ironic one: it has excellent facilities for high-voltage electricity transmission. They were provided for the experimental fast-breeder reactor at the nearby Dounreay site.

Dr Musgrave maintained that wind systems could meet as much as a quarter of the UK's present electricity needs. Hill-sited wind-generating systems of 1MW output each could be economic if the price of oil reached £37-£51 a tonne or coal £20-£27 (it is currently £18). There were, however, serious objections to hilltop installations—scenic disfigurement, problems of access and the profusion of transmission lines that would result.

Instead, Dr Musgrave, said he preferred a seaborne installation, and he envisaged offshore clusters. A dozen such clusters, each of 400 wind machines, could be sited in the shallow waters of the Wash and be expected to deliver 12 000 MW, or 20 per cent of UK demand, into the national grid at an estimated cost of £500installed kW—or 1.4p/kWh.

The inquiry heard other state-of-the-art submissions on alternative energy sources, including hydropower, tidal barrages, and conservation. The SEI presentation produced little in the way of hard cross-examination from BNFL.

After Scargill and some of the experts who have given evidence on alternative energy will be questioned later.

US creates energy department

Peter Gwynne, New York

The Department of Energy became an official part of the United States cabinet last week when President Jimmy Carter signed the legislation creating it. To no one's surprise, Carter promptly nominated his energy czar, James Schlesinger, who produced the administration's ambitious energy plan, as the first head of the new department. Schlesinger was quickly approved by the Senate, and will take the helm when the energy department starts operations in autumn.

The new cabinet agency, the first created since the Department of Transportation in 1966, draws personnel and political influence from a number of existing cabinet departments and federal agencies, most notably the Energy Research and Development Administration. The energy department will start off with 20 000 employees and a first year budget of \$10 600 million. These resources will be used to oversee most of the roughly 50 separate energy programmes run by the federal government. In signing the authorising legislation,

Carter praised members of Congress for their speed in approving the new department. The process took only five months, extremely rapid given the normally placid pace of a Congress that frequently flexes its muscles in the direction of the administration to indicate its influence in running the nation's affairs. The new department, said Carter, will help him to alleviate the effect of inevitable shortages of oil, gas and other supplies, lead to increased production of energy, and ensure that the public pays fair energy prices. "We will have an energy policy to make our nation proud," declared Carter.

Meanwhile, the House of Representatives, by a vote of 244 to 177, approved an energy bill that included almost everything the administration asked for in its April energy message. The only major loss from the administration's proposed programme was a standby increase in petrol taxes that would have gone into effect if Americans consumed too much of the precious resource. □

Coal clean up

One major facet of the Carter administration's energy policy is its increasing reliance on coal to provide a homegrown source of energy for Americans. But Carter has also sought to strike a balance between energy and environment. Last week he signed into law a set of controls on strip-mining that give the federal government, rather than the coal-producing state governments, the right to insist that mine owners clean up after their operations.

The struggle to obtain the legislation was a long one. Environmentalists started their efforts to brighten up the ugly, scarred landscapes that are typical of surface coal country in the US 10 years ago, but until this year industry lobbyists had blocked any federal legislation, with the help of vetoes by President

Gerald Ford in 1974 and 1975. "I'm not completely satisfied with the legislation," said Carter at the signing ceremony. "I would prefer to have a stricter strip-mining bill." Nevertheless, he continued, "I think that this provides us a basis on which we can make improvements in the bill in years to come."

The bill requires owners of strip mines to restore land that they have stripped for coal to approximately its original contours, to grade sheer rockfaces left by the mining, to replant trees and grass, and to prevent any pollution of waterways as a result of the stripping. The bill also provides a new tonnage tax—greater from stripped coal than the deep-mined variety—to restore lands scarred by the coal industry's uncontrolled strip-mining in the past. □

It soon became evident that the eastern hemisphere appeared to be colder than the western: at an altitude of 65 to 70 km there was a temperature discrepancy of some 18°C. The US and USSR rocketry is designed to explore the crucial mesosphere where temperatures range between 0°C and about -80°C.

The US and USSR measure temperature by different techniques: the Americans use a thermistor device; the Russians, a resistance thermometer made of tungsten-rhenium wires. The mismatch may stem from this difference.

The two participants are also ironing out discrepancies in wind velocity measurements. Both countries employ similar wind-data equipment—a parachute system tracked by radar. In the Wallops Island tests NASA is tracking the Soviet wind-chutes, but the Soviet scientists will process the data. In that way they hope to reveal the source of the error. □

Tonight's the night for meteors

Cloud-cover permitting, Britain's star-gazers should be in for a treat tonight (Thursday) and tomorrow night, when the Perseid meteors are expected to put on a good show. Would-be meteor watchers can expect to see as many as 60 meteors an hour just before dawn—and some 50 of these will come from the Perseid shower. Conditions are particularly good for meteor watching this year because there will be no Moon visible to brighten the sky. □

Conferences should run to London

London appears to be an unusually satisfactory location for conference organisers anxious to protect their delegates from "traveller's diarrhoea," according to a report published this week by Dr B. J. Freedman, of King's College Hospital. Out of 584 participants at the 9th European Congress of Allergology and Clinical Immunology, 363 completed a questionnaire on the subject and only 0.6 per cent of visitors from abroad contracted "the runs" in the 10 days of the conference, compared with 2.8 per cent of "indigenous participants". Corresponding figures published for meetings in warmer climates are invariably much higher, including 29 and 49 per cent for congresses in Mexico, and 40 per cent for Teheran. None of Dr Freedman's respondents had taken preventive drugs, and he attributes their good fortune to "a cool climate and north American standards of hygiene". Appropriately enough, his report appears in *Journal of Hygiene* (vol 79, p 74). □

US spending record

In 1977 the United States will spend \$40 800 million on research and development, according to figures published by the US National Science Foundation. Basic research will take \$5.2 billion; applied research \$9 billion; and development \$26.6 billion. The total is 9 per cent higher than the \$37.3 billion spent in 1976—a real increase of 3 per cent when inflation is taken into account. R&D spending will be 2.2 per cent of the US's gross national product this year—the same fraction as last year, and significantly below the 3 per cent peak of 1964. The federal government's spending is expected to reach \$21.8 billion in 1977: last year it spent \$19.8 billion. In 1976 some 542 000 scientists and engineers had full-time jobs in the US, an increase of 2 per cent on the previous year. □

THE NEW SCIENTIST

20 years ago

The caution that has been exercised in testing maleic hydrazide before introducing it into common use in Britain is most commendable. Too often a new chemical is let loose on the world without waiting for the inevitably lengthy cancer tests.

New Scientist, 8 August, 1957



Let the sun shine in

A series of Acts harking back to the First Amendment ensures that information about government is freely available to the American public, whereas in Britain . . .

Dan Greenberg
is publisher of *Science and Government Report* and is New Scientist's correspondent for Washington View

professional advancement the almost certain reward for the successful hunter, and scarcely any chance of government retribution.

Furthermore, the government itself often assists the hunter, though it may do so reluctantly. Even when the revelation process sends vast shock waves through the body politic—witness Watergate—the basic principle of press freedom faces no serious challenge. This is not to suggest that there are no problems confronting press freedom or that there are no efforts to clamp down on the press. There are many, but when gauged against the legally sanctioned iron curtain that Britain's official bureaucracies can draw around their misdeeds, the American scene is a veritable journalistic paradise. Critics, of course, contend that the US system of unrestricted press freedom is good for journalism but bad for government. That argument, however, has few adherents, and to understand why it is useful to take a look at the laws, traditions, and political realities that govern operations of the press here.

Foreign interest in press-government relations here often

for journalists who have practised their profession in the grim shadow of Britain's Official Secrets Act, a working visit to Washington usually evokes astonishment. There's an unending open season here on government secrets, with glory and

focuses on the so-called "sunshine laws" that have been enacted over the past decade: the Freedom of Information Act (1966), which requires the federal government, upon request, to deliver a wide variety of official documents to any citizen applying for them, regardless of the purpose; the Federal Advisory Committee Act (1973), which requires most government part-time advisory committees—of which there are about 2000—to meet in public, and the Government in the Sunshine Act (1976), which requires most full-time government committees and boards to do the same.

These laws have indeed been useful for opening government proceedings to public view, and the openness principle that they embody can be credited with many notable revelations, among them the fine detail of FBI surveillance of American citizens over three decades; in recent weeks, documents obtained through the Freedom of Information Act revealed the CIA's long-term programme to develop chemical and other means of controlling human behaviour.

But as a matter of fact, the sunshine legislation is only peripheral to the peculiar relationship that exists between press and government in the United States. The initial pressure for these laws originated in Congress, and in the main, received only lip-service support from major news organisations.

Even today, relatively few reporters avail themselves of those legal devices for obtaining information. The reason, quite simply, is that even before the passage of

the sunshine laws, the press was able to lead a free-wheeling existence in its quest for information about the government, while holding immunity from government retaliation.

The basic element in the relationship is written deep into the Constitution, the First Amendment of which specifies that "Congress shall make no law . . . abridging the freedom of . . . the press". Plain and simple words, and though subject to a great deal of controversy in the context of national emergencies and on such fringe matters as pornography, the basic principle has remained virtually intact throughout the history of the Republic. Congress doesn't make laws that abridge the freedom of the press.

Against that constitutional background, there is another vital fact that affects the operations of the press. In contrast to the parliamentary system of the executive branch being rooted in the legislative branch, the American system is deliberately divided. The President gets to the White House solely by being a candidate for the presidency. Once in office, the President is the boss of the executive branch of government, and the Congress—whose majority can be of a different party—takes up its role of accepting or rejecting his requests for money and programmes.

In the process, an adversary relationship exists between the two branches, as is the case at present, though Jimmy Carter is a Democrat and the Democrats control Congress. The tension between legislative and executive can be acute or mild, but whatever the degree, the two branches are constitutionally distinct. And that sets up a happy situation for the press, for in their conflicts with each other, the two branches of government often use (and sometimes manipulate) the press for their own political purposes.

When there are news "leaks" in Washington, as there often are, there is a real likelihood that one or another of the branches is feeding information to the press for the purpose of gaining an advantage in its struggles with the other branch. Or to refine the matter still further, there's a good chance that a particular member or faction in Congress is performing the deed, or that somebody in a part of the executive branch is the culprit (or hero). For it must be recognised that British-style discipline is nowhere to be found in the US government.

Independent baron

The Congress consists of two houses, which often are sparring with each other, and party discipline in those houses is a bit of a joke. Each of our 100 Senators and 435 Representatives exists as a kind of independent baron, identified with one of our two major parties, but free to do as he pleases.

The executive branch is a bit more disciplined, since all its senior officials are appointed by the President. But the orchestration is often a bit ragged, and if a department head wants to stop or start something against the President's wishes, it is not unusual for him quietly to call in a favourite reporter or two to present his case in the most favourable manner.

By deliberate design, then, the government is divided against itself, which accounts for the fact that even prior to passage of the sunshine laws, secrets here flowed like the Potomac in the rainy season. And that also accounts for the fact that our major news organisations showed little interest in the campaign to pass the laws. They were getting along quite nicely, thank you, without a helping hand from the government they were prying into—mainly because elements of that government found it advantageous to hand-feed the press. Though the press has become more sophisticated in recent years in employing the Freedom of Information Act to pry loose government documents, ironically, in the opening years of the Act the press lagged behind in using it. Precise figures are hard to obtain, but it appears to be the case that trade associations and various business interests quickly latched onto the Act as a

means of obtaining information of commercial value. That wasn't the intent of Congress, which pushed hard for the sunshine laws as a means of ventilating the executive bureaucracies that had become ingenious at evading Congressional requests for information. Congress wanted to hand the press a tool to open up the Johnson and Nixon administrations, which had devised an assortment of means for withholding information to which Congress felt entitled. The press response, at least at first, was that it had its own ways of getting at such stuff.

When it comes to real serious secrets, such as those involving grave matters of national security, it turns out that we do have a mini-version of the Official Secrets Act, but it is riddled with loopholes. Known as the Espionage Act of 1948, that statute states that it is a crime to give a foreign power or to make public information whose disclosure could injure the United States. But to clinch the case, it must be shown that the disclosure was made with the intent to injure the US or with reason to believe that it would.

The courts have been wary about the relationship of this statute to the First Amendment's protection of freedom of the press. Since intent in such matters is an extremely unlikely motive for the press, and, furthermore, is very difficult to prove, the Espionage Act simply does not figure in the average reporter's calculations as he goes about his work of hunting for government secrets. In fact, few reporters are aware of the Act's existence.

The big difference, of course, between the Official Secrets Act and our Espionage Act is that the former draws a line around a vast amount of information and forbids its revelation, regardless of the value of the information or the intent of those revealing it. The Espionage Act, on the other hand, sets up a difficult barrier for those who would crack down on the sppliers of the government's secrets.

In addition, the courts here have held that to prove violations of the Espionage Act, it must be shown that the intent to do the nation harm was accompanied by a clear and present danger that harm would ensue. The Official Secrets Act bans the unauthorised publication of government data—period.

One effect of the sunshine laws has been to wash away the old myth that candour can flourish only in secrecy when sensitive government matters are under consideration. The exemptions in the act exclude disclosure of classified matters of current national security interest, medical and psychiatric data concerning government personnel, information of commercial value that businesses are required to furnish to government, and so forth. But this still leaves out in the open a vast amount of material that once was regarded as too sensitive for routine public disclosure. Nevertheless, the stuff has been coming out in vast quantities without any evidence of harm to the public interest or to the proper functioning of government. The fact that inter-office memoranda may be legally scooped up by an inquisitive reporter probably makes officials a bit cagey about committing themselves to paper on sensitive matters. On the other hand, the possibility of disclosure also concentrates the mind and furnishes an incentive for doing one's duty properly.

From abroad, it may appear that the American press is an unleashed beast, rambling freely and hungrily through the halls of government. In fact, it is a bit slotful, often it's not very bright, and frequently it is misled by its sources in government. But in its clumsy fashion it more or less serves the purpose that was intended by the First Amendment and that has been enhanced by our sunshine laws. We do not assume that government is wise and good, for often it is not. And one of the main ways of finding this out is to let the press run free. It is an imperfect instrument, but no one has yet devised a better one for the intended purpose. □



Novosti

Tunguska: the final answer

Work published this week confirms that the 1908 Siberian mystery explosion was the first observed impact of a comet with the Earth

Ian Ridpath
is editor of the
*Encyclopedia of
Astronomy and Space*
(Macmillan, London;
Crownell, New York)

in the fall area. A farmer on his porch 60 km away said that the heat from the fireball seemed to be burning his shirt, and a neighbour clasped his hands over his ears to protect them from scorching. The blinding bright-blue bolide, trailing a column of dust, disintegrated explosively, producing a blast wave that knocked the first farmer off his porch. Sounds like thunder rumbled in the air. Farther north, nearer the centre of the fall, several of the nomadic Tungus people were thrown into the air by the blast, and their tents were carried away in a violent wind. Around them, the forest began to blaze. As the dazed locals cautiously inspected the site of the blast they found scenes of terrifying devastation. Trees were felled like matchsticks for up to 30 km around.

Leонид Куллик, the Soviet mineralogist who first investigated the Tunguska event, initially supposed that it had been caused by the impact of a gigantic iron meteorite, like that which produced the Arizona Meteorite Crater. But when he first reached the remote site in 1927, to his surprise he found no such crater. Evidently, the object had not been an iron meteorite, and it never reached the ground. These findings started a controversy about the Tunguska event that continues to this day.

The English meteorologist Francis J. W. Whipple and the Soviet astronomer I. S. Astapovich proposed in the 1930s that the event had been caused by the explosive disintegration in the atmosphere of the head of a small comet. This proposal was backed up in 1962 by the discovery around the site of tiny particles of magnetite (magnetic iron oxide) and glassy droplets of fused rock: a low-density, stony composition containing flecks of iron is believed to be typical of interplanetary debris. Further support came in 1966 when the Tunguska body's orbit was deduced by Vasilii Fesenkov of the Soviet Academy of Sciences' meteorite committee. From the direction and

On the morning of 30 June 1908 a blazing fireball descended to Earth in the valley of the Stony Tunguska river, Siberia, 800 km north-west of Lake Baikal. Its searing heat melted metal objects and burned reindeer to death in

angle at which it struck the Earth, Fesenkov concluded that the object approached from behind the Sun, and was therefore never seen because it was always veiled by the Sun's glare. The bright comet Mrkos of 1957 followed such a path and was not discovered until it had passed the Earth's orbit while receding from the Sun.

But these conclusions have not been accepted by the followers of a controversial alternative theory of the Tunguska event, which claims that it was caused by the explosion of a nuclear-powered spaceship. Supporters of this theory ask: What about radioactivity at the site? Aren't there signs of radiation damage at Tunguska which prove that it cannot have been a comet?

Much of the popular lore about radiation from the explosion stems from the fictional writings of Soviet author Alexander Kazantsev, who first put forward the nuclear-explosion theory in a science-fiction story of 1946. His tale visualised the burn-up and explosion of a nuclear-powered spaceship from Mars which had come to pick up water from Lake Baikal, the largest volume of fresh water on Earth. One of Kazantsev's characters speaks of a man who, shortly after examining the blast area, died in terrible pain as if from an invisible fire. "It could be nothing other than radioactivity," explains the fictional character. But there are no real-life reports that any such thing happened. The Tungus people did refer to "scabs" which appeared on the backs of their remaining reindeer after the fall, but most likely these were simply heat burns caused by the same flash of thermal energy that set fire to the trees.

The possible existence of anomalous radiation at the Tunguska site was carefully checked by geochemist Kirill Florensky of the Soviet Academy of Sciences who led expeditions to Tunguska in 1958, 1961, and 1962. Florensky reported that the only radioactivity in the Tunguska trees was fallout from atomic bombs, which had been absorbed into the wood. Reports of accelerated forest growth in the devastated area, which some put down to genetic damage from radiation, was another point that Florensky's party looked at in detail. They concluded that only the normal acceleration of second growth after fires had taken place.

In fact, the only evidence for possible nuclear effects associated with the Tunguska blast comes from the radio-

carbon levels in the rings of two trees, one near Los Angeles and the other outside Tucson, reported by Clyde Cowan, C. R. Atluri, and Willard Libby (*Nature*, vol 206, p 861). The authors found a 1 per cent jump in radiocarbon content in the rings of each tree for 1909, the year following the Tunguska explosion. No solar effects occurred around that time to explain the increase, although local factors in the US south-west might be the cause. (It must be mentioned that careful measurements from a tree at Trondheim, much nearer the blast, made by J. C. Lerman, W. G. Mook, and J. C. Vogel of the carbon-14 Research Unit at the University of Groningen (*Nature*, vol 216, p 990), show no radiocarbon increase in 1909, but rather a steady decrease around that time).

A comet could still do it

Cowan, Atluri, and Libby calculated that their observed radiocarbon increase would be produced by the neutrons liberated from a 5-megaton nuclear explosion. According to the most accurate analysis of the Tunguska explosion, by geophysicist Ari Ben-Menahem of the Weizmann Institute in Rehovoth who compared old seismograms of the Tunguska event with those of modern nuclear air explosions, the Tunguska body exploded with a force of 12.5 megatons at an altitude of 8.5 km (*Physics of the Earth and Planetary Interiors*, vol 11, p 61).

Now John Brown of Glasgow University and David Hughes of Sheffield University show in this week's *Nature* (vol 268, p 512) how the radiocarbon data of Cowan and his colleagues can still be explained by the physics of a cometary entry into the atmosphere. They note that, although the temperature produced by the burn-up of the comet in the atmosphere would have been no more than a few million degrees, too low for nuclear reactions, it is "entirely fallacious" to suppose that sub-nuclear temperatures cannot produce nuclear effects. Such temperatures are found in solar flares, which produce nuclear-like effects of ionisation and high particle velocities. Therefore, Brown and Hughes propose that the impact of a comet with the atmosphere would produce X-rays, gamma rays, and highly accelerated electrons and nuclei.

By comparison with solar flares, the authors calculate that sufficient neutrons could be produced to account for the radiocarbon data of Cowan and his colleagues if the hot plasma generated by the comet's passage through the atmosphere endured for just a few seconds, which is quite in line with the duration of meteor trails and the time for which observers watched the passage of the Tunguska body. Thus, even if the Tunguska event did cause nuclear effects, that would still not invalidate the identification of the Tunguska body with a comet. "Nothing more exotic need be invoked," say Brown and Hughes.

With hindsight we can see that a smaller-scale version of the Tunguska event occurred on 31 March 1965 when a meteorite fragmented explosively over the town of Revelstoke, Canada. No crater was found, only traces of black dust which showed that the meteorite had been a carbonaceous chondrite, a composition believed to be typical of much interplanetary debris, including comet heads. Carbonaceous chondrites are so fragile that few survive the passage through the atmosphere; the Tunguska object must also have been a carbonaceous chondrite.

But sceptics of the comet theory have so far doubted that an object large enough to cause the Tunguska event would have been invisible, as the astronomers claim. This doubt was dispelled by a practical demonstration in 1976, when an asteroid, now numbered 1976 UA, passed the Earth at a distance of just over one million km, avoiding a direct repetition of the Tunguska event by only a few hours. Although termed an asteroid, 1976 UA is one of that class of objects believed to be the nuclei of "dead" or degassed comets. Its diameter is only a few hundred metres, similar to that of the Tunguska comet, making it the smallest object observed in space. Even at its closest, 1976 UA was too faint to be seen without a large telescope. At the same closing speed as that calculated for the Tunguska object, 40 km/s, 1976 UA would not have been visible to the naked eye until 25 minutes before impact had it come out of a perfectly dark sky. But of course the Tunguska object struck in daylight. Therefore it is not surprising that the Tunguska comet was not seen as it approached the Earth on that sunny morning in 1908. □

Recent results from the USSR

A complex expedition has been out to the Tunguska site from Tomsk University every summer. The joint efforts of a wide range of specialists have now made it possible to come much closer to a solution of the Tunguska mysteries.

The work done by Academician G. I. Petrov and his colleagues has established that as the cosmic body moved through the atmosphere, its substance rapidly evaporated and, when a large amount of vapour had amassed in front of the travelling body, it exploded and scattered in the atmosphere. The scattered matter then condensed into tiny "balls" which gradually descended and settled on a vast area.

These tiny meteorite balls, a few tenths of a micrometre in diameter, were sought not in the soil, but in the peat of sphagnum bogs, which receive mineral nutrition only from the air. As a result, the Soviet scientists discovered small fused silicate particles, up to 800 micrometres in size, in the 1908 peat layers. A microchemical analysis showed that they were, surprisingly, composed of a set of elements most unusual in classical meteorites—they were rich in rare-earth and heavy elements. Earlier, a spectral analysis of the ash of trees which had survived the catastrophe, and had been cut down on hilltops not far from the epicentre, had also revealed in some samples a high content of rare-earth elements. Quite recently, scientists found the "Tungus" set of elements during a rocket probe of noctilucent clouds. In both cases meteoric matter had evaporated and again condensed in the Earth's atmosphere.

But the quantity of meteoric particles found locally over the entire area of felled timber proved to be very small—no more than several tonnes at most, while the total mass of the meteorite had been estimated at approximately 100 000

tonnes. What had happened to the greater portion of the cosmic matter?

"The results of a laboratory analysis of materials of the last expedition, which we have just received, provide an answer," Professor Vasiliev said. "Numerous soil and peat samples were taken last summer in the area of the epicentre to determine their cosmogenic radiocarbon content. An analysis of the samples at the Institute of Geochemistry and Mineral Physics, Ukrainian Academy of Sciences, revealed that considerable amount of cosmogenic material had fallen near the epicentre in the form of silicate particles. It is quite possible that the total amount within the area of destruction alone runs into at least thousands of tonnes."

Cosmic silicate particles are, as a rule, very small—less than 200 micrometres. A kind of marker—cosmogenic radiocarbon—helped scientists carry out the delicate job of detecting this cosmic dust in the 1908 peat layers. The method had been evolved and successfully employed by Kiev researchers. Unlike the "meteoric balls" which are the product of smelting at the moment of explosion, the silicate particles are original and of extraterrestrial origin. Moreover, acute-angled particles of meteoric iron were discovered in the peat. Researchers had already come across them in samples collected by Kulik and Florensky, but now it has been proved beyond doubt that these plesiotypic particles were directly associated with the meteorite.

The latest data make it likely that the Tungus meteorite was a comet. Its chemical composition is akin to that of the so-called carbonaceous chondrites and this substance is probably a component part of comet nuclei.

Y. Vostrukov

The Risk Equations

The case against lead in petrol

Despite government controls, last year saw a totally unnecessary increase in the tonnage of lead added to petrol. Recent research shows that this lead eventually forms a significant proportion of body lead burden, making the case for stricter controls increasingly convincing.

John Mathews
is a postgraduate student at Imperial College, London, and a committee member of the Campaign Against Lead in Petrol

research progressively lowers the limits of "acceptable" exposure. The technological justification for adding alkyl lead compounds to petrol as octane boosters is now nothing more than special pleading. Once it might have been true that the octane demands of high compression car engines could only be satisfied by such additives: but now the refining process itself is perfectly capable of producing the fuel required.

Yet the British government, and the public authorities which advise it, show not the slightest evidence of any determination to deal with the hazards posed by lead. Last December, the Department of the Environment announced a programme of phased reductions in the maximum lead content of petrol. But this programme has, so far, made no impact on the actual lead content of petrol. Indeed, the oil companies increased their total lead consumption in 1976 by 2.5 per cent. This lack of determination is obvious when Britain's efforts are compared to other governments'. In the US, the Environmental Protection Agency (EPA) has successfully enforced regulations requiring lead-free fuel to be available at all but the smallest filling stations and has recently won a series of court battles against the manufacturers of alkyl lead compounds in order to impose overall limits on lead in petrol. The average lead content of the gasoline pool is to be reduced to 0.13 g/litre by January 1979. In Germany the second phase of the 1971 Lead Law, imposing a ceiling of 0.15 g/l of lead in petrol has been in force since 1976. Denmark, Norway, Sweden, Austria and Switzerland have implemented legislation reducing the ceiling to 0.40 g/l, while Japan has virtually banned lead entirely from regular grade fuel. The Soviet Union eliminated lead from all petrol sold in cities from 1959. Yet the current British maximum is 0.50 g/l.

No-one disputes that about 75 per cent of lead in petrol ends up in the air as a fine aerosol, or that vehicle exhausts account for over 90 per cent of the lead in air in cities. Lead also accumulates in the environment, so even remote areas can be contaminated. Dr Clair Patterson, of Caltech's Division of Geological and Planetary Sciences, carried out an exhaustive analysis of lead contamination in an entire ecosystem in Thompson Canyon of the Yosemite National Park. Dr Patterson's work, which will be published later this year in the Archives of Environmental Health, reveals that, in Thompson Canyon, 50 per cent of the lead in soil humus, 90 per cent of lead in plants, and 95 per cent of lead in animals can be traced to airborne lead mostly from vehicles over 200 miles away.

What is in dispute is the contribution of airborne lead to total body lead burdens, and whether these burdens are approaching (or have exceeded) safety limits. The debate has been sharpest in the US. After the EPA issued

Fears about the health effects of lead in the environment are no longer front-page news. Yet the case for tighter control of lead in petrol, a major source of environmental lead, is stronger than ever. Lead contamination is still increasing, and at the same time medical

regulations restricting the use of lead in gasoline in 1972, the four manufacturers of lead anti-knock compounds (DuPont, Houston Chemical, Ethyl Corporation and Nalco Chemical) together with the National Petroleum Refiners' Association, sought a judicial review before the Court of Appeal for the District of Columbia. The EPA claimed: 1 blood lead levels of 40 $\mu\text{g}/100\text{ ml}$ and higher indicate a danger to health;

2 airborne lead is directly absorbed in the body through respiration to a degree which constitutes a health risk; 3 airborne lead (most of which comes from vehicles) falls to the ground and mixes with dust and dirt posing a significant danger to children in cities.

Since this court hearing, the EPA has revised its "safety" level to 35 $\mu\text{g}/100\text{ ml}$, and a prestigious committee of the US National Academy of Sciences has estimated "safety" levels of 30 $\mu\text{g}/100\text{ ml}$ for individual children, and of 20 $\mu\text{g}/100\text{ ml}$ on average for the child population at large.

The point of quoting these "safety levels" for lead in blood is that the range of values typically found in an urban population today already overlaps them. This doesn't mean that people are walking around showing symptoms of frank lead poisoning, such as lead "colic" or lead "palsy". Such symptoms become apparent only at blood levels of 70-80 $\mu\text{g}/100\text{ ml}$. But even at lower levels, lead is interfering with metabolic processes in subtle ways to produce mental and physical effects which can only be classified as "subclinical" but are nonetheless very real.

Dr Oliver David runs a clinic for hyperactive children (children who are restless and unable to concentrate) at the Downstate Medical Center in Brooklyn, New York. Sometimes a child's condition can be traced to a known cause (birth trauma, for example): but not always. Working on a hunch that lead might explain these other cases, Dr David sampled blood lead levels and found a significant difference between levels in children whose hyperactivity had a known cause and those whose illness had no other apparent explanation. More to the point, David produced a rapid improvement in the condition of the second group by administering a lead chelating agent such as penicillamine which binds lead and allows it to be eliminated from the body. Dr David interprets these unexpected results as suggesting a much wider relationship between lead and mental retardation than had been suspected.

Elegant animal studies

In hearings before the US Court of Appeal, Ethyl Corporation argued that this association between lead and hyperactivity did not prove causality, and that David's results might be explained by hyperactive children being more likely to pick up lead from dust or paint chips—that is that hyperactivity causes lead ingestion, not the other way about. This argument is refuted by a series of elegant animal studies, which show that young animals develop symptoms of hyperactivity or mental impairment as a result of exposure to low doses of lead. In one of these experiments, Ellen Silbergeld and Alan Goldberg, at the School of Hygiene and Public Health in Baltimore, found that adult mice exposed to low levels of lead (insufficient to cause overt lead poisoning) exhibited no oddi-



Ingram Print

ties in behaviour. But when suckling mice were exposed to similar doses, their growth was retarded by 10 per cent and they developed symptoms of hyperactivity, but no classical symptoms of lead poisoning.

Apart from its behavioural effects, lead in low doses has been implicated in the disturbance of foetal development. (There is also some evidence of its association with the production of genetic changes, the disturbance of immunological reactions, and in the reduction of fertility.) Lead has long been known as an abortifacient, although when it was used to procure abortions in Victorian times it frequently killed the mother as well as the foetus. But can lead be implicated in "spontaneous" miscarriages, stillbirths and preterm deliveries? At Reading University, Professor Derek Bryce-Smith and colleagues analysed the tissues of undiagnosed stillbirths, and found their lead levels to be significantly higher than "normal" (as determined from newborn children killed accidentally). Bryce-Smith makes the point that "factors promoting stillbirth may be relevant to abnormal postnatal development of children born alive".

Similar work has been carried out by Professor D. G. Wiberley in the Pharmacy Department of Aston University. Wiberley found that in only 7 per cent of normal births were placental levels of lead greater than $1.5 \mu\text{g/g}$, whereas 61 per cent of the stillbirths or neonatal deaths studied had levels greater than this.

Underlying all these toxic effects of low doses of lead there must be some metabolic effects of lead that can be studied at the cellular level. One such effect is the disturbance lead causes to the biosynthesis of haem. Haem is not only the oxygen carrying part of the haemoglobin molecules in blood, but is also a constituent of cytochromes, the site of energy metabolism inside the cell. One of the enzymes involved in this pathway, delta-aminolevulinic acid dehydratase (ALA-D), turns out to be extremely sensitive to the blood lead levels. At blood lead levels of $35 \mu\text{g}/100 \text{ ml}$ (the EPA's present danger level), ALA-D activity in red blood cells is markedly inhibited. Since the inhibition is reversible, some have been willing to write it off as a biological curiosity. Not so Professor

Robin Cole, at Sussex University, who heads a group studying the fundamental mechanisms of embryonic development. In a letter to *The Lancet* last year Cole announced that he had isolated blockages in the foetal growth of rats and mice induced by disturbance of haem synthesis exactly of the kind induced by lead, and he suggested that this might be worth further research. Crucially, there is no threshold for the inhibition of ALA-D activity by lead.

Subtle hazards such as effects on ALA-D synthesis, foetotoxicity, and behavioural toxicity are difficult to prove. But the agencies regulating lead in petrol (or in food or water for that matter) ought to make conservative, "fail-safe" assumptions. The burden of proof should rest on those claiming that the hazard is non-existent. However, even accepting that the subtle hazards of lead are real dangers, there is still a need to show that lead from petrol, and not some other source, is threat.

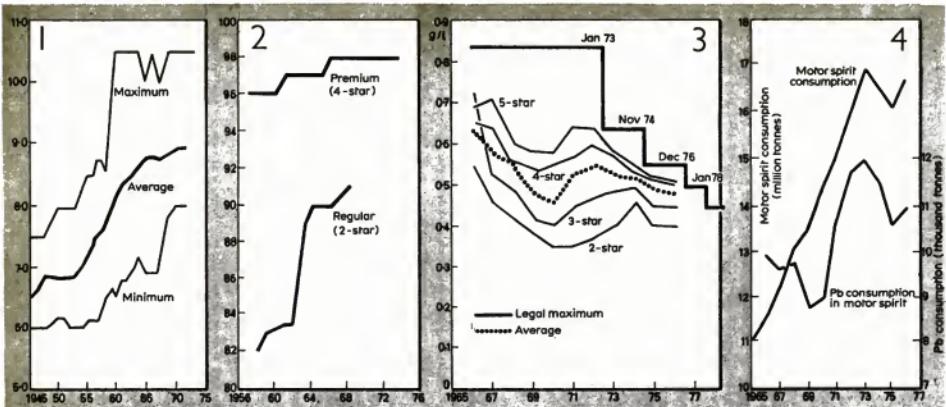
Birmingham City Council was already concerned about lead when the Gravelley Hill interchange connecting the M6 and the M1 opened in 1972. It decided to screen people living near the motorway to see if the massive increase in traffic (from 361 040 cars per week in April 1972 to 748 639 in March 1973) would have any impact on their body lead burden. Five months after the opening of the interchange, the blood lead levels of men in the area has risen by 31.5 per cent (and women's by 36.6 per cent). After 18 months, these levelled off to a 64.7 per cent increase for the men, and 75.7 per cent for the women. Measurements of airborne lead taken by Dr John Butler of Aston University show that daytime averages of $1.03 \mu\text{g}/\text{cubic metre}$ rose by over 100 per cent in 5 months and by over 200 per cent within a year of the opening of the interchange.

There is, however, considerable opposition to the idea that airborne lead levels are related to blood lead levels. Professor Patrick Lawther, head of the MRC Environmental Hazards Unit, carried out one of the most often-quoted studies of this relationship. He found no appreciable difference in blood lead levels between permanent day-shift and night-shift taxi drivers in London. But no attempt was made to check the men's off-duty exposure to lead, their eating habits, or any other relevant exposure. And only 50 men in all were monitored. The implication of this work is that lead in food and drinking water is the major, if not only, source of lead in the body.

But there is much evidence to contradict this view. In studies at Harwell, funded by the oil companies, Dr A. C. Chamberlain measured the uptake of lead by human volunteers who inhaled the exhaust from a car running under controlled laboratory conditions. To distinguish inhaled lead from the background of lead entering the body from other sources, the exhaust lead was tagged with a radioactive marker. The results showed that, when breathing normally, just over a third of the lead inhaled was retained in the lungs and absorbed into the bloodstream. Of this lead, half remained attached to red blood cells, and half was deposited in various tissues.

This work provides strong evidence of the significant absorption of airborne lead by the body. It does not resolve the vexed question of the contribution of airborne lead to the total body burden—not only via breathing, but indirectly via the lead that settles on dust and soil and is ingested in food. But evidence on this issue is coming from a team at the Department of Planetary and Space Science, UCLA, led by Dr M. Rabinowitz. He added a radioactive lead tracer to the diet of experimental subjects and monitored its appearance in tissues and excretory products, calculating that airborne lead contributed $17 \mu\text{g}/\text{day}$ to body lead burdens—about one-third the total from all sources.

Even more interesting results are coming from the



UK trends: (1) increase in new car compression ratio; (2) trends in octane number; (3) lead content in fuel; (4) increase in petrol and lead consumption

work of Dr W. I. Manton at the Department of Geological Science, University of Texas at Dallas. In a paper to be published later this year, Manton explains how he found fortuitously that the ratio between different isotopes of lead in the air of Dallas over the period 1967 to 1975 exhibited an irregular sawtooth pattern—a pattern unwittingly generated by the manufacturers of lead anti-knock compounds changing sources of lead. Using this pattern as a "fingerprint", Manton demonstrated that airborne lead accounted for 31.4 per cent and 37.1 per cent of total lead burden of two subjects.

Thus there is sound, if yet limited, data upon which to base estimates of the impact of a ban on lead in petrol on public health. The risk side of the risk/benefit equation is at least beginning to take shape. But what of the benefits claimed for adding tetra-ethyl to petrol, and the supposed penalties that would result from a ban?

The total amount of lead added to motor spirit has increased steadily since the 1920s. In 1971 West Germany passed its Lead Law, envisaging a staged reduction of lead in petrol to 0.40 g/l by January 1972 and 0.15 g/l by January 1976. Sweden promptly followed suit but has since faltered after the 1973 energy crisis.

In the US, and especially in California, the control of pollutants such as hydrocarbons, carbon monoxide and nitrogen oxides from cars has been an over-riding concern, and the elimination of lead from petrol has been almost a by-product of this concern. The reason for this is that the catalytic converters adopted by the car makers to meet emission standards happened to be poisoned by lead. Nevertheless, when the EPA issued regulations in 1972 for a phased reduction in the lead content of gasoline, the oil companies and alkyl manufacturers challenged in the courts its authority to enforce an *overall* reduction. It was only in 1976, when the Supreme Court refused to hear an appeal from the manufacturers, that the authority of the EPA was upheld, and the reductions enforced.

Eliminating lead from petrol has different implications for the petroleum and car industries, a point aptly illustrated by German and US experiences. Present oil refineries generally produce a motor spirit fraction of octane rating 88-91, before the addition of lead boosts the rating to 98-100 to make combustion smoother in engines with high compression ratios. There is no problem for the oil industry in producing lead-free regular (2-star) grade fuel—with an octane rating of 90—suitable for cars with

medium compression ratio engines. The problem is that high compression ratio engines would knock badly if forced to run on this grade of fuel. So two long-term strategies for eliminating lead from petrol seem possible: 1 make cars with medium compression ratio engines, to allow them to run on 91-92 octane fuel; 2 maintain the production of high compression ratio engines, and require the oil companies to extend their refining capacities to produce fuel of 98 octane without resorting to lead.

Clearly the costs of the first strategy fall mostly on the motor industry, while the costs of the second would be borne by the oil companies. In Germany, where Volkswagen had already invested heavily in the medium compression ratio Wankel engine, the motor industry eventually insisted on being provided with low-lead grades of fuel. In the US, the motor industry, under the pressure of the EPA's emission standards for other pollutants, insisted on a supply of lead-free regular fuel that would not poison its proposed catalytic converters. Both countries demonstrate that the easiest path to non-lead petrol is to build engines with lower compression ratios.

The UK government has yet to give any indication which strategy it will follow—if any at all. In 1972 the Conservative government announced a 3-stage reduction in the maximum lead content of petrol from 0.84 g/l to 0.45 g/l by 1976. This programme was blown off course by the oil crisis, and the new Labour government took until March 1976 to announce its intention of falling in line with the EEC standard of 0.40 g/l by 1981. Although a reduction to 0.45 is scheduled for January next year, the implementation of the 0.40 limit is still a matter of intent, not law.

Certainly there are costs involved for both motor and oil industries in the transition to lead-free petrol. But these should be seen as inherent costs of petrol-engined transport. The British government estimates that removing lead from petrol would add 1.2p per gallon to the cost of petrol. This amounts to an admission that lead gives petrol a competitive edge over other fuels, at the expense of the environment. In economic terms, lead in petrol acts as a negative tax discriminating in favour of petrol-engined vehicles and against other forms of transport, such as diesel-powered buses and electrically-driven trains. If prices were allowed to reflect true costs, consumers could make their choice accordingly. □

Monitor

Hormones share a communal trigger

Fat cells burn carbohydrate in response to insulin; involuntary muscle cells contract in response to noradrenaline. But if Michael Schramm and his collaborators at the Hebrew University of Jerusalem are right, fat cells could just as easily be activated by noradrenaline or muscles by insulin—by a literally superficial change in their molecular architecture (*Nature*, vol 268, p 310).

They have done experiments which show that the choice of hormone (or neurotransmitter) to activate any given cell type is—for many cells—quite arbitrary. There's nothing about noradrenaline itself, for instance, that is necessary to make a muscle contract: all it does is to trigger a "go" signal inside the cell which in a muscle cell causes contraction, in a secretory cell secretion . . . and so on. The universality of the "go" signal could have profound implications for drug design.

The trigger itself is the receptor on the surface of the cell that recognises the hormone or neurotransmitter molecule. The receptor, when it binds the

hormone, activates an enzyme inside the cell. That enzyme, adenylate cyclase, starts the "go" signal in the form of cyclic AMP, the so-called second messenger that induces the cell's response.

Schramm and his associates have shown that any receptor can probably activate the adenylate cyclase of any cell. They did it by mating such disparate entities as a turkey red blood cell and a mouse tumour cell, one of which lacks the receptor for noradrenaline and the other adenylate cyclase. Would the hybrid cell have the receptor from the one coupled to the enzyme from the other?

They tested it by adding the drug isoproterenol to the culture medium. Isoproterenol is a noradrenaline mimic—and when added to the hybrid cells, it proved effective in activating them, showing that the receptors had indeed become coupled to the adenylate cyclase. Variations on this experiment, with other cell types and a different kind of receptor also worked—substantiating Schramm's claim of something like universality.

The conclusion that Schramm and his co-workers draw is that while one end of the receptor may be specific for noradrenaline or some other hormone—its other end (the one that sticks through the cell surface to the interior) must be identical for all cells that work by activation of adenylate cyclase.

Now in theory that means you could repair a cell that was defective in receptors (and such cellular diseases do exist) by sticking analogous receptors from cultured cells onto them. The technology for that, let alone for sticking the repaired cells back into their owner, doesn't exist. Alternatively, you might be able to find a drug that could get into the cell and imitate the intracellular end of the receptor. . . . All pure science fiction at this stage—and there are important hormones and neurotransmitters that don't work through adenylate cyclase. Even so—a "go" signal that works for numerous cell types across species and even genera has the authentic feel of an important biological principle. □

Seismic scorpions track down their prey

The nocturnal sand scorpion (*Paruroctonus mesaensis*) is an astonishingly good hunter. In total darkness it locates insects up to 50 cm away and quickly gets into position to catch its prey. It has to be fast, as the burrowing cockroaches that form the bulk of its diet bury themselves as soon as they detect the scorpion's approach. Philip Brownwell, at the University of California at Riverside, has done some experiments to discover how the scorpion finds its prey (*Science* vol 197 p 479).

Brownwell had to master two disciplines, seismology and neurobiology, to get the answer. First he had to see if the movements of an animal on the desert sand would be transmitted through the sand for any distance. He used piezo-electric transducers to create and measure disturbances of the sand, and found that sand could conduct two sorts of wave.

There was a fast wave that spread out spherically from the disturbance and a slower Rayleigh wave travelling out in a circle on the sand surface. (A Rayleigh wave is one where the particles move in a retrograde upright ellipse on the surface of the medium. At the top of the ellipse the particles move in the opposite direction to the wave as a whole.) Having shown that sand will transmit information, especially as surface waves, Brownwell now had to turn to the scorpion and show that it could use this information to locate prey.

When it is out hunting the scorpion takes up a characteristic stance with its legs spread out in a circle about 5 cm across. At the tip of each of the eight walking legs are two types of move-



Paruroctonus mesaensis photographed at night by ultraviolet light

ment sensitive receptor; the tarsal hairs that support the leg on the sand and a group of eight slit receptors in the cuticle of the last joint in the leg. The Rayleigh waves travel at about 40 m per

second so the scorpion has to pick up the waves and measure the delay between the first and last legs to detect the waves (about 1 msec).

Brownwell managed to insert micro-electrodes into the two types of sensor and record their response to a simulated cockroach at various distances. At 5 cm the hairs and the slit receptors both responded, but as the distance increased the tarsal hairs began to fail. By 20 cm only the slit receptors responded, so they must be the system used for locating prey at long distances. Other studies confirmed this view. Removing the tarsal hairs had no effect, while making a small hole (250 micrometres) in the cuticle of the slit organ on particular legs systematically altered the scorpion's accuracy. So, sand can transmit, and scorpions can translate. □

Cheapness, not efficiency, is best bet for solar cells

There are two approaches to the problem of utilising solar energy by photovoltaic devices. The first of these is to look for materials and engineer devices with the highest possible efficiency; the other option is to aim for lower efficiencies but sufficient cheapness to make such devices economic.

Dr C. D. Mathers of the University of Sydney has recently performed an interesting analysis of the basic science which limits the ultimate efficiency of photovoltaic cells (*Journal of Applied Physics*, vol 48, p 3181). His rather general approach to the problem makes his arguments applicable to any photovoltaic solar cell with a single energy gap, whether it be a *p-n* junction, a Schottky barrier cell or a semiconductor-electrolyte interface cell.

By calculating the rates of photon ab-

sorption and radioactive decay of electrons promoted to the conduction band of the absorber, and relating these quantities, Mathers is able to obtain an expression for the efficiency of such solar-cell materials in terms of three factors: one which arises because only a fraction of the incident photons are absorbed; a temperature dependent ratio of the open circuit voltage to the size of the energy gap in the semiconductor; and a power matching factor.

Mathers concludes that, even with an ideal cell with negligible internal resistance and stimulated emission, an energy gap of 1.3 eV would yield a maximum efficiency of about 30 per cent for solar conversion. Other less general analyses have in the past arrived at a similar figure. So, cheapness, not efficiency, is best. □

Monitor

continued

In search of antibodies' patchwork genes

A good many researchers in recent years have been poring over catalogues of amino-acid sequences of antibody molecules, looking for clues as to how a limited number of genes produces a virtually unlimited range of antibodies. And a range of bizarre models has been devised to explain the phenomenon. Now a new way of analysing those sequences has revealed sites which may be junctions between different components of composite antibody genes.

One feature of all the models is that the variable (V) region, the part of the molecule which differs from one antibody to another, is originally encoded by a separate gene from the remaining constant (C) region: the two genes are fused end-to-end during the development of the immune cells. But the V-region may itself be composite, since most of the variability is confined to three "hyper-

variable" (HV) regions within it. The new work supports the suggestion that the HV regions are inserted into the V-region gene during development just as the V-region is joined onto the C-region gene.

The new analysis, by workers at Rehovot in Israel, is simple in principle: they applied the genetic code, which relates the amino-acid sequence of a protein to the nucleotide sequence of the DNA that encodes it, to amino-acid sequences of various antibodies. Thus they worked out what the nucleotide sequences of their genes would have been, and could look for patterns in those sequences. In fact, about the only meaningful pattern that is easy to find is the inverted repeat, in which a given sequence can pair up with a complementary copy of itself farther along the DNA; so they programmed a com-

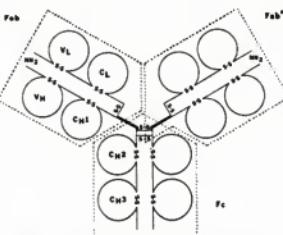


Diagram of antibody molecule showing constant (c) and variable (v) regions

puter to look for those. And they found a goodly number of them, in just the best places—one each side of each of the HV regions, and one or two at the V-C junction, in each of the genes they analysed.

The catch is that in many instances the genetic code allows a choice of nucleotides for a given amino-acid, so for some of the proposed inverted repeats it will be up to the DNA sequencers eventually to decide whether they are there or not. But many of the inverted repeats are established well enough by this indirect method, and the consistency with which the others appear at the interesting places, and almost nowhere else, suggests that they may all be confirmed when the genes are properly sequenced.

The point is that among the many roles assigned to inverted repeats is that of signals saying "cut DNA here". So the inverted repeats flanking each HV region could mark where that segment has been cut out and inserted into the V-region gene. Even if they mean something else altogether, they at least confirm that the HV regions are distinct from the rest of the molecule. (The work is reported by C. Wulmatt, J. Urbain and D. Givol in *PNAS*, vol 74, p 2526.)

Bouncing balls in a laser beam tests rainbow theory

Two physicists from Bell Telephone Laboratories have been spending their research time suspending balls on a vertical laser beam like ping pong balls in a fountain (*Physical Review Letters*, vol 38, p 1351). A. Ashkin and J. M. Driedzil have thus measured the force that a plane electromagnetic wave exerts on a dielectric sphere to a new order of accuracy and should be able to test the amazingly complex theory of the interaction. The dynamics and optics of clouds, in the atmosphere and in space, can depend on these forces, so Ashkin and Driedzil have not worked in vain.

The interaction of the spheres and the light can, in principle, be calculated by "Mie-Debye theory", which the new method should be able to check. This begins by analysing the incoming plane wave into a sum of components each with a different angular momentum about the central diameter of the sphere (a technique somewhat similar to Fourier analysis). The forces between wave and sphere are then calculated for each angular momentum separately.

A crucial parameter in the analysis is the number of angular momentum components, or "partial waves", which contribute to the scattering. The relevant number of partial waves is about equal to the ratio of the diameter of the sphere to the wavelength of light used. This ratio is called the "size parameter". If the size parameter is small, the number of partial waves that contribute is also small, and the calculation can be carried out by hand. With larger spheres, for example droplets of water in clouds, where the size parameter varies between 100 and 5000, the calculation must be done on a computer. The complete analysis of a rainbow, for example, which is caused by light scattered from water droplets, is a complicated affair because the size parameter is large.

The Mie-Debye calculation shows that

the force on a large dielectric sphere fluctuates rapidly as the size parameter increases. This may be understood as being caused by a resonant effect among surface waves, waves travelling circularly round the outside of the sphere, rather than the normal internally reflected waves.

The fluctuation effect should be a critical test of the Mie-Debye theory; but now the experimental means to observe it have emerged, it appears that the computations have not yet been made sufficiently accurate for the test to be water-tight. Computations with higher numbers of partial waves will have to be made.

The authors also suggest that their technique may have practical applications. It provides a quick and very accurate method of measuring the diameter of the spheres (to 1 part in 10³). Present technology for measuring the size of small spherical particles gives an accuracy of only 1 per cent.

Cells in the lab make natural opiates

The past year has seen some half-dozen natural molecules emerge with activities resembling those of the opiate pain-killers. Most of these "endorphins", including one of the two enkephalin molecules which started the whole chase off, seem to be fragments of the grandfather molecule β -lipotropin, which is made in the pituitary gland. But what their relationships are, and which one belongs where in the body, remain problematical. The problems may be eased with a line of pituitary cells that make endorphins in the lab.

The cell line was one of several tested by G. Giagnoni, S. L. Sabol and Marshall Nirenberg at the National Institutes of Health, Bethesda (*PNAS*, vol 74, p 2259). They looked for endorphins by their ability to inhibit the adenyl cyclase enzyme (yes, cyclic AMP is in on the act) in a way which was blocked by a specific anti-opiate drug. The test came out positive with a clone of cancer cells from

the anterior pituitary gland of a mouse.

The pituitary is the source of many of the body's hormones, and these cells also make a melanotropin—possibly a fragment of the non-endorphin part of β -lipotropin—and the related hormone corticotropin, perhaps from a linked gene.

The cells make at least four endorphins, but only two in substantial amounts: from their fairly high molecular weights, they may be the fragments of β -lipotropin known as α - and β -endorphin. One of the minor species is small, but is probably not an enkephalin. The absence of any enkephalin in the cloned cells tends to confirm the growing belief that they and the larger endorphins belong in different places, the first in the brain and the second in the pituitary (see *New Scientist*, vol 72, p 159).

Now that at least some of the endorphin molecules can be made by a well-defined cell line, it should be easier to sort out the relationships among them. □

Meteoritics at Cambridge

The world's meteoriticists gathered at Cambridge University recently for the 40th annual meeting of the Meteoritical Society. Over 200 papers in four working days covered a vast range of topics

The Cambridge meeting came at a time when more scientists are actively engaged in meteoritical research than at any time in the past. More fresh meteorite falls are now being recovered, especially in under-developed countries, thanks to a greater awareness of the value of meteorites. In addition, more meteorite finds are now being made (see "Fallen stars by the tonne", by Dr Keith Hindley, *New Scientist*, vol 75, p 20).

A total of over 1050 meteorite specimens has now been recovered by Japanese and American searchers in blue ice areas of the Antarctic coastal regions. They include three irons, a stony iron, and hundreds of stones including several carbonaceous chondrites and achondrites.

Preliminary dating of some of the meteorites has startled scientists. Normally, weathered meteorites have terrestrial ages of up to 10 000 years, implying that meteorites weather down to unrecognisable form quite quickly. However, one meteorite recovered by the Americans has been dated at over one million years, while several of the Japanese stones exceed this and one reaches four million years. Antarctic recoveries therefore offer an opportunity of studying meteorite populations as they were in the distant past. In addition, the exceptional freshness and preservation of the specimens may mean the recovery of normally very friable and readily weathered types.

Several sessions were devoted to work on the carbonaceous meteorites, the most primitive meteorite type and a potentially invaluable source of information on the early solar system. Argon dating of a number of separate components of the Allende meteorite have yielded remarkably consistent results suggesting they formed together about 4.54 billion years ago, in a very short space of time. There is, however, one remarkable exception—white inclusions in some coarse grains which consistently give a date of 4.91 billion years. This could be due to unknown or unlikely effects disturbing the true age. If not, then the component represents material which is of presolar origin, having formed 400 million years before the main part of the solar system.

Recent recoveries of unusual meteorites have included a 596-gramme stone identified as ureilite or carbonaceous achondrite. The specimen was among the batch of rocks recovered in Oman during 1958 and forwarded to Queen Mary College, London. This very rare specimen is strongly crystalline and has exceptional hardness. Another recent recovery has been a new carbonaceous achondrite which shows a remarkable amount of metamorphism. Carbonaceous stones show little of heating effects in their history and have not previously revealed features common in hypersthene, bronze or amphotic chondrites. Mulgar West, found in Australia, shows extensive meta-



Two of Canada's 23 meteorite craters, the 20- and 15-mile Clearwater Lakes

morphism with an opaque magnetite occupying the place of the metal phase in a texture normal for ordinary chondrites. This unique stone demonstrates that at least one carbonaceous parent body underwent extensive reheating.

Soviets v. Canadians

Among the highlights of the week were the first detailed studies of the Zhamashin structure, situated near the Irghiz River in Kazakhstan, USSR. This eroded meteorite impact feature (astrobleme) was first identified in 1969 and consists of an elevated 10-km-diameter ring surrounding a basin partially filled with sediments. Brecciated blocks up to a metre across thickly cover the outer slopes and these contain coesite, stishovite and other classic features of intense shock. There are large deposits of shock melt and the crater and its immediate surroundings are scattered with lumps of dense black glass. These are very similar to the tektites found in several areas of the world and can be divided into two types. A less numerous low-silica group are clearly derived from the shock melting of local granitic rocks, while the more numerous high-silica tektites would appear to be the result of shock melting of soil and surface deposits. Irghizites, as they have been named, contain 1100 parts per million of iron.

The Russians have shown an increasing interest over the last decade in astroblemes and the list of confirmed structures in the USSR has now risen to 21. They range from the 1.4-km Zeleny Gay crater up to the 100-km-diameter Popi Gay Basin. The majority are found in Soviet Europe. The Russians are now rapidly catching up the Canadians, the leaders in astrobleme fieldwork. At the meeting, the Canadians announced their 23rd crater, a five-km-diameter feature centred on Gow Lake, Saskatchewan. The

lake's central island is severely brecciated and the rocks show intense shock effects. The Canadian features now range from simple bowl shaped craters, two km across, to giant multi-ranged structures 100 km across, with ages of from 5 million to 1.8 billion years. The scattering of confirmed astroblemes in Canada and European Russia is now about the same at three features per million sq km, and the size distribution is very similar in the two areas.

An intriguing study of faint ring structures in the US by John Saul suggests that there might be a deeply penetrating fundamental plumbing system in the Earth's surface—the final memory of the intense meteorite impact bombardment which all the planets underwent about 3.9 to 4 million years ago. The original craters have by now been eroded away, but the underground faulting, which must have penetrated to a great depth, should still be there. Saul has illuminated large-scale relief maps at a grazing angle to reveal masses of faintly outlined ring structures. Some are very obvious, others very faint—and all are circular. Over 2000 rings have been listed for the western US, the Appalachians and Alaska, from 5 km across to 700 km.

The more obvious features are certainly real and seem to represent fracture systems because they correlate with mineral deposits. In many areas the majority of known deposits of copper, silver, gold, lead, zinc, molybdenum, tungsten, and vanadium lie on rings. In one area alone, 24 out of 24 mineral deposits lie on main rings which take up only 9 per cent of the ground area. The evidence is very suggestive but the rings are faint and Saul is going to have problems convincing the sceptics. As he put it, the rings are the smile of the Cheshire cat rather than the Cheshire cat itself.

Keith Hindley

Technology

Britain throws down the glove on microwave landing

Extensive testing at Brussels airport has shown that the British-developed Doppler microwave landing system (MLS), which is competing with US/Australian and German systems in a contest to select a standard replacement for the present instrument landing system (ILS), does not suffer from the errors which US studies had predicted.

Computer simulations carried out by the Lincoln Laboratories suggested that the Doppler MLS could encounter multipath errors—false readings caused by signals from the ground transmitter being reflected by nearby buildings—at a specific point on the approach to runway 07L at Brussels. No such distortion, however, was encountered during 130 approaches with a Hawker Siddeley Andover of the Royal Aircraft Establishment equipped with Doppler MLS. In contrast, the mathematical model forecast a peak-to-peak error of up to 0.22°—compared with an agreed limit of 0.10° for the ILS replacement—but the trials at the specified ground speed of 98 knots and threshold height of 50 ft resulted in a typical error of only 0.04°.

The significance of these results is that they cast doubt on the US simulation studies which contributed to the majority recommendation last March in favour of the US/Australian TRSB (time-reference scanning beam) system by the All-Weather Operations Panel (AWOP) of the International Civil Aviation Organisation (ICAO), which has been examining the question of an ILS successor. The British and German members of AWOP challenged the voting procedure and disassociated themselves from the majority decision; ICAO's Air Navigation Commission also stated specifically that it did not endorse the panel's recommendations.

The international-standard New Guidance System is to be selected from Doppler MLS, TRSB and DLS (the German candidate) by all 128 member states

of ICAO at a meeting next April. The latest meeting of the 30-state ICAO Council—the organisation's rulemaking body—asked the Secretary-General to draw attention in his letter to members to the fact that AWOP's assessment rested largely on predicted performance and recommended that the competitors should "carry out flight trials at typical airports of the equipment proposed and make the results available" by April 1978.

The Brussels trials were observed by the French and Dutch members of AWOP, and representatives of other interested parties. The United States member was invited to attend but, according to US reports, the telegram—which was sent through normal channels and which was confirmed by the US Federal Aviation Administration as having been received—never reached him. The Lincoln Laboratories simulation was by an oversight based on the presence of a building which does not exist, and

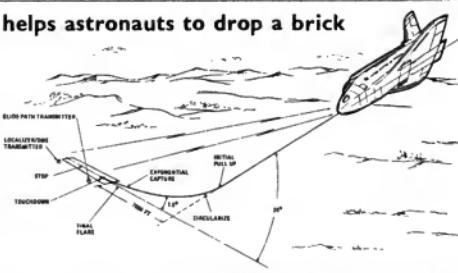
this complicates evaluation of the test's validity. Doppler MLS has, however, shown that it works well at a site chosen by the US—however misguided—as being "optimally disadvantageous".

Trials are now taking place at Stansted and will later be carried out at Gatwick. These will be followed in the autumn by three months of demonstrations overseas, allowing a detailed summary of the results to be prepared by November in time for collation, translation into ICAO's other official languages and submission to the member states.

A major advantage of Doppler MLS is the ease and rapidity with which it can be set up. The prototype was operating at the Bedford trials site on a Monday morning and transmitting correct signals at Brussels airport on the Wednesday afternoon, having been transported from Britain by sea. TRSB, by contrast, depends on accurate beam-forming and requires a lengthy setting-up process. □

MLS helps astronauts to drop a brick

NASA's Space Shuttle, which is due to make its first free landing in the next few days, will use a microwave landing system as an approach aid when returning from space. The gliding qualities of the Shuttle Orbiter resemble those of a brick outhouse, and All-Cutter Hammer has developed a version of its MLS to cater for the vehicle's unsuccessful tussle with gravity—if a world-weary occupant jumped over the side at 20 000 ft, the Orbiter would beat him down. The Shuttle is fitted with a fairing over



the rocket-engine nozzles for initial tests, reducing the approach glideslope to some 10°, but on operational missions the spacecraft will descend at about 24°—although the sink rate at touchdown will be as little as 1 ft/s. □

Taking the strain out of crack detection

Engineers who used so-called "Big 5" routine inspection techniques to discover the cracks that grounded a number of British Airways Tridents last week might have been able to detect the incipient weaknesses if they had access to a novel electro-optical strain recording instrument from Canada. Developed by Diffracto of Ontario, the device makes use of a diffraction pattern to allow monitoring of the actual mechanical strains that occur in given components or structures such as airframes rather than the accelerations measured by most methods.

The Big 5 conventional techniques involve radiography, X-rays, gamma sources, eddy current testing and dye penetrants.

The instruments contain a miniature semiconductor laser, a precisely-engineered optical "gap" and, in one version, a motor driven film cassette on which

is stored a strain versus time record. The gap, of about 0.03mm, is made by two metal arms each resin-bonded to the surface under examination about 75 mm apart. The laser beam is aimed through the gap generating a diffraction pattern—light and dark fringes whose spacing is related to the width of the gap. The diffraction pattern in fact operates like an optical lever with very small changes in gap width giving rise to easily discernible changes in fringe spacing.

Several versions of the recorder are under development. One version, to become available shortly, features up to four sensor units connected to a central microprocessor. This will facilitate continuous monitoring of strain at a number of points in an aircraft, generating a complete strain histogram for the points under inspection. In this version, a photodiode tracks the position of a particular bright fringe.

In another version the optical signal will be stored on a film cassette which is motor driven to give a complete strain/time profile for a particular flight: a special playback unit allows the optical track to be converted into analog or digital output for analysis.

According to Walter Pastorius, one of the designers of the system, first flight trials of the system will take place shortly in a Canadian airforce F104 aircraft. Initial interest has been in military aircraft because these are normally subjected to higher operating stresses than commercial planes. Another, different, application could be in nuclear reactors. Although the cost of the diffraction equipment is greater than that of conventional types, it is insignificant when compared with the cost of an aircraft. Pastorius says that he does not fear the effects of vibration on the diffraction pattern, which some aircraft engineers believe could reduce the system's effectiveness. □

Stopping 'under-run' by energy absorption

An energy absorbing bumper claimed to minimise the effect of "under-run" accidents where a car runs into the back of a truck and under the rear overhang, will soon be tentatively marketed in Britain. In such accidents it matters little whether the occupants are wearing seat belts or not—the most usual consequence is that they are decapitated.

Although it might seem callous to mention it, the lorry is often badly damaged too, even if fitted with fixed under-run bumpers. The relevance of this may be judged from those statistics that are available. Between 1971 and 1974, over 2000 heavy goods vehicles involved in such accidents suffered rear damage.

It has not proved easy to persuade lorry operators to buy safety, especially if the benefit is to other road users. So the new bumper's manufacturer will be pitching its sales talk on the theme of reducing damage to the lorry.

It has a start, however, as Scammell Trailers plans to fit 25 of the hydraulic energy absorbers on to some of its trailers within the next three months as a sort of "free gift" to selected customers. The idea is to demonstrate to operators not only that such a device



The energy absorbing bumper could protect car passengers from injury in a 30 mile/h impact

does exist, but that it can save money—as well as providing road safety benefits. The hydraulic energy absorber has been designed and developed by Gunter Persicke, who was also responsible for the hydraulic crash barriers along the central reservation of the Chiswick Flyover in London.

The unit itself consists of a very sturdy frame, pivoted at the top edge with hydraulic cylinders forming the third side of the triangle featuring progressively tapered grooves in their

borders. It is being manufactured by Quinton Hazell.

Persicke claims that the type of rear bumper commonly in use is largely ineffective in preventing injury to car occupants at other than very low speed impacts and is also very easily damaged itself, putting the trailer off the road.

Crash experiments have been done at the Transport and Road Research Laboratory, Crowthorne, using the normal bumper, a reinforced (virtually a rigid) version of it and the hydraulic energy absorbing type. Persicke claims that with the latter in place, belted car occupants can survive an impact of 30 mile/h or more—and the truck and its bumper are undamaged.

A side benefit to buyers of the new bumper is protection of the truck and loading bays. Many drivers back up to a loading bay using the rear bumper as a "feeler". A sensor can be fitted to the hydraulic bumper which will tell the driver when the bumper is in contact with the bay while the energy absorbing qualities will prevent serious damage.

The production unit will, it is also claimed, be light in weight thus confounding the other objection to such devices usually raised by fleet operators—that they cut payload. □

The principal advantages of this walking dredger over present day types are the ability to operate in higher sea conditions and to cut hard seabeds. Although no details are yet being given, IHC Holland is confident that an order is about to be placed for the first such platform



Walking dredger cuts a dash

A design of "walking" dredging platform that overcomes the severe problems of cutter dredging in swell should be able to cut a channel up to 17 m deep and 65 m wide in a single sweep of seabeds consisting of hard materials such as sandstone, limestone and coral. Conventional, floating, ladder dredgers need their cutters held fairly steady both for optimum output and avoidance of damage.

It will be able to dredge in waters between 4 and 15 m deep with wave heights of 4.5 m and wind speeds of up to 65 km/h. The platform will also be able to withstand waves 6 m high and wind speeds of 130 km/h.

The platform is the work of IHC Holland which has been studying the use of dredging platforms offshore for

many years: details of a "three-legged" design were released five years ago. This model, however, did not have the power to cut into hard substrates.

The new design, WADSEP (walking and dredging self-elevating platform), arose from design studies for a harbour channel in the Middle East. It consists of two pontoons, each with four "jack-up" legs, linked by two bracing lattice girders. The cutter "ladder" is suspended between the two pontoons. It carries a 2000 hp cutter and a suction pump of a similar power.

The platform walks on four main legs, one at each corner, which can move longitudinally. Each movement advances the platform a distance of three metres. On completion of the cutting stroke, the weight of the platform is

transferred to four auxiliary legs, the main legs are raised and then moved to the forward position. The legs can be raised at a speed of 16 m/h. Minor changes in direction can be achieved by asymmetrically loading the legs. One man controls the entire operation.

An allied and equally important problem in turbulent seas is to ensure a continuous discharge of the dredging spoil. WADSEP has two 30 m long suspended pipes which are capable of limited horizontal and vertical movements to deliver dredged material to attendant vessels. The IHC system will be used with automatically positioned hopper vessels.

The new platform, although not cheaper than existing vessel-mounted systems, has many advantages for offshore work. It will be able to work in seas three times higher than vessels using spuds (pins lowered into the seabed) and about twice as high as anchored vessels.

Its advantages over sea-going trailing suction dredgers will be its ability to cut through hard rock and to excavate precisely a broad channel within a defined area. Where there is a choice of dredging in soft substrates or in hard rock, conventional systems will be favoured, but in creating new harbours or constructing offshore islands such choices are not always possible. □

Technology

continued

High hopes for the winged bean

Low protein levels in dietary staples underlie much of the malnutrition found in developing countries. In many parts of the humid tropics, the people have to rely largely on root crops such as cassava, yam and potatoes, which have 1.2 per cent protein levels. In these circumstances, a crop which grows well in the humid tropics, which has edible high-protein leaves, flowers, seedpods, seeds and tubers, and which, by reason of its superior nitrogen-fixing ability, improves most soils in which it grows, sounds like a plant-breeders' dream. But it is a fair description of the tropical winged bean, *Psophocarpus tetragonolobus*.

The bean appears to have originated in south east Asia and is an important garden crop in several countries there. In Papua New Guinea, where it is most common, it is an ingredient of some of the tribal rituals, suggesting that it has been grown there for many years. In parts of Africa, it grows wild, but is not cultivated.

Traditional methods of cultivation vary from country to country. In the Highlands of Papua New Guinea, where the bean is grown as a commercial crop, farmers plant different varieties for high tuber yields than for high seed yields. In Burma, the same effect is obtained by staking for seeds and letting the plants ramble on the ground when grown for tubers.

The winged bean plant is a vine which may grow to 3-4 m high, when staked. It is an herbaceous perennial but is usually grown as an annual. There are many varieties, with wide differences in flower colour, pod size, etc. The pods are four-sided, with fringed wings, and vary in length from 6 to 36 cm. They may contain from 5 to 20 seeds each, varying in weight from 0.06 to 0.4 g. The bean is one of the best nitrogen fixers known, carrying as many as 440 nodules per plant, with diameters up to 1.2 cm. This excellent nodulation has appeared without inoculation wherever the plant has been grown, an important quality in the humid tropics where soils tend to lose their fertility quickly.

Its nitrogen-fixing ability may also explain its relatively high protein content. The seeds have 30-40 per cent protein and 17 per cent edible oil, which compares favourably with soybean. Like soybean, the seed protein value is limited by the content of sulphur-containing amino acids and the seeds contain a phytohemagglutinin and a trypsin inhibitor, and must be cooked. The seeds are also rich in tocopherol which is a bonus in areas where Vitamin A is deficient.

As for the rest of the plant, the tubers have 12.15 per cent protein, unusual in a root crop, and the leaves and flowers have 5.15 per cent protein.

Plant growth seems to be fairly tolerant of altitude, growing well from sea



Psophocarpus tetragonolobus

level up to 2000 m though for good yields, humid conditions and short days are necessary. The bean does not flower if grown in more temperate regions, and this appears to be more a function of day length than of temperature. It has been grown in drier areas under irrigation with good results, but it will not survive prolonged periods of drought.

The tubers, flowers, pods and seeds are elements of the diet in several Asian countries. The tubers are boiled or wrapped in banana leaves and roasted, much like potatoes. The pods are used fresh in salads or boiled briefly for a vegetable or a snack. The seeds are often roasted for several hours and eaten like peanuts; or, in parts of Indonesia, they are used to make a cheese-like substance, similar to the tofu made by the Chinese from soybeans. The flowers are also eaten, and when fried in oil they have a mushroom-like flavour.

Until recently, little research was done on this promising plant. In 1973, a research programme was begun at the University of Papua New Guinea. Dr T. N. Khan and his colleagues began to make a germ plasm collection. They found 121 separate varieties of *Psophocarpus tetragonolobus* in Papua New Guinea alone. Detailed varietal studies in other countries such as Ghana and Sri Lanka are now being done, and considerable variation is showing up.

At about the same time, research on the bean was underway at the University of Ghana and at the International Institute of Tropical Agriculture in Nigeria. Also, a paper entitled *Psophocarpus tetragonolobus—A Crop With A Future?* was published by Dr G. B. Masefield,

then of Oxford University. All of this work focused international attention on the winged bean and led the National Academy of Sciences in America to set up a panel of international scientists to study its research needs and potential. Their report, *The Winged Bean—A High Protein Crop For The Tropics*, was published in December, 1975. It brings together all the information then available on the winged bean, pinpoints problems and recommends study areas.

Since then, the Asia Foundation in California has sponsored the formation of an international steering committee, with Dr Khan as the research coordinator. The committee, through Dr T. Hymowitz at the University of Illinois, is publishing a winged bean newsletter, the first issue of which was in May 1977.

There are now some 25 countries involved in work on the winged bean. Germ plasm collection and classification is underway in several more Asian countries and field trials are being done both in Asia and in other areas of a similar climate where the bean is not native. Nutritional studies are being done on the more promising varieties. Work is also being done on the production of winged bean milk and other food derivatives. Among the agronomic studies are a couple of inter-cropping experiments. In Malaysia, the Rubber Research Institute has grown the bean plants between rows of rubber trees. In the Cameroon, the vines are being grown with sorghum, whose stalks provide poles for the beans to climb on. Hopefully, the nitrogen fixed by the beans will improve the alternate crop yield, while the bean harvest will increase the profitability of the crop.

Another facet of the work with *Psophocarpus* is the encouragement of winged bean cultivation by small farmers and gardeners. This includes such things as the test and demonstration plots being established by the Asia Foundation in Indonesia and by the Nestle Foundation in the Ivory Coast. To make the spread of winged bean cultivation and consumption possible, it is necessary to develop a good seed supply. This has begun, with the production of a tonne of seed of each of two of the most promising varieties at the University of Florida, again with the support of the Asia Foundation.

While the winged bean shows great promise as a subsistence or small scale commercial crop, its viny growth habit precludes its use as a field crop, since mechanical harvesting would not be cheap or convenient. The University of Papua New Guinea is trying to overcome this problem by producing a "bushy" mutation by seed irradiation.

In Britain, work at Kew Gardens has been so far confined to preparation of a monograph of the nine species in the genus, but research into relationships with wild relatives continues. □

Digital TV is on says IBA

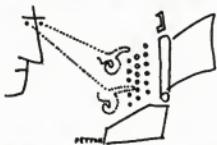
The Independent Broadcasting Authority has now demonstrated that an all-digital television studio is feasible. The main advantages of handling television signals in digital, rather than analog form, stem from the robustness of digital signals and their ability to be transmitted, recorded and copied any number of times without degradation, provided that the handling system has an adequate bit rate capability.

The long-term study undertaken by the IBA laboratories at Winchester has been predominantly concerned with overcoming the problems of recording the high bit rate needed for television on magnetic tape, without increasing the cost of tape transport construction and tape consumption to prohibitive

Paralytics can type with their eyes

Typing at 60 characters a minute may not seem a great speed but to people who are unable to move their hands or use their vocal chords, it is a considerable achievement. A device has recently been developed by a post-graduate student at the University of Toronto's engineering department, which gives paralytics the ability to type at the rate of one character per second.

The device works by optically tracking the minute movements of the eyes as they focus on a small screen. The screen contains all the letters of the alphabet and some numerals. Most paralysed people, including those suffering from



Waste disposal puts fluid bed on solid ground

Applications for fluidised bed combustors are now becoming more widely established. An ideal use is the burning of refuse primarily because it ensures complete combustion and minimises, or even eliminates, gaseous pollution in the form of acid or alkaline fumes.

Consulting engineer Arnold Pearce has now devised a means of burning rubbish of all kinds more cheaply and completely and, he claims, without atmospheric pollution of any kind. The plant is a circulating fluidised bed (CFB) and is both cheap to install and to run than a conventional furnace. A demonstration plant is under development in Western Australia. Such plants can be used either as a simple incinerator or linked to a boiler to provide steam for electrical power generation.

The CBF incinerator is also a good deal

levels. Ideally, this means recording colour TV signals to current broadcast standards on 50 mm (2 in) videotape at 19 cm (7.5 in) per second.

To digitise a British PAL colour TV signal, it is ideal to sample the analog waveform at a frequency which is directly related to the colour subcarrier frequency (4.4356 MHz). According to well-tried Nyquist theory, it is necessary to sample any analog signal at twice the highest frequency which it contains, if acceptable results are to be obtained, giving an unmanageably high sampling rate and tape speed.

The IBA engineers have, however, followed in the footsteps of BBC work, which shows that the worst effects of sampling at sub-Nyquist rate can be

diseases such as cerebral palsy, retain control over their eye movements. The screen, optical tracking mechanism and control circuits are all mounted on to an ordinary spectacle frame. When the eye rests on a letter for one second, the digital controls instruct an electronic typewriter to type out that character.

written to type out that character. The device, reported in Canadian government periodical *Canada Weekly* (vol 5, No. 26, June 29), has been tested with quadriplegic patients, at least one of whom grasped the method effectively in under half an hour. The principle has been tried before, admits inventor Ken Anderson but not with much success.

Anderson, but not with much success. Previous attempts had relied on bulky equipment which required considerable time to set up and would cease to function when the paralytic became uncomfortable and wanted to move his head. Anderson's device, with its microcircuitry, moves with the paralytic. It takes about 40 seconds to set up and can be used for as long a time as the patient wishes. The prototype costs \$1000 but it is claimed that a commercial version, using standard components, could be produced for around \$500. □

smaller and easier to install than conventional incineration equipment, and can be used to consume a very wide range of fuels and mixtures of fuels, ranging from ordinary coal through plastic waste and sewage sludge to raw domestic refuse. It can readily be adapted to run off agricultural wastes available on a large scale, such as bagasse which can be used to power sugar cane processing.

In the CFB, sand is first heated up to around 800°C by blowing burning gas through it. Then a stream of pulverised refuse is blown in, together with air to maintain combustion. The unique feature of the circulating bed is that air from beneath is fed in at different pressures at different points creating a continual movement in the bed like a slow wave, so that particles on the surface are constantly reburied. This circulating effect prevents any unburnt particles being carried up as smoke in the exhaust and ensures that combustion is complete. □

overcome if a digital "comb-filter" is used to remove from the signal those components which will cause ambiguities or "aliases" in the final bit stream. Although comb-filtering inevitably degrades resolution, a no-loss compromise has been adopted by the JRA

The material is recorded at sub-Nyquist rate (twice colour sub-carrier frequency or fsc), but it is originally sampled and handled at all other stages of the digital train at four times fsc, which is well above Nyquist level. Already prototype mixers enable pictures to be mixed, wiped and super-imposed without reconversion to analog.

So far, the IBA has been working only with a modified, but otherwise conventional, analog video recorder. This has a capability of approximately 40 Mbit/s and can be used to record only half-width colour pictures. However, the Authority now hopes to modify the recorder—for instance, by doubling the heads—to double the bit capability and enable handling of full width pictures. □

Feedback

If tube trains affect trees, what do they do to us?

Underground trains in San Francisco generate magnetic fields that are 1000 times stronger than the natural background. They are so strong that they set up measurable electric currents in trees.

They must also generate electric fields in people, points out the Stanford University researcher who discovered them, and may well have long-term effects. He also wonders what their effect is on migrating birds, which may use magnetic fields to navigate (see *New Scientist*, last week, p 292).

Antony Fraser-Smith of the Stanford Radioscience Laboratory points out that San Francisco's new Bart system, as well as other rapid transit systems, are really a set of varying current loops. Current leaves a transformer-rectifier substation, passes along a third rail to the train, drives the motors, and returns to the substation via the running rails. As the train moves, the size of this loop changes.

Windmill bonus

Not only will windmills power the alternative society, they will also block out the propaganda of the industrial society—by disrupting TV reception. Thomas Senior of the University of Michigan studied the problem for the US Energy Research and Development Administration (ERDA). He found that rotating metal windmill blades generate electro-magnetic pulses that play havoc with the visual part of the signal (*Chemical and Engineering News*, 18 July). A 300 ft diameter windmill of the type ERDA plans to test would cause the entire picture to flip over in rhythm with the blades as much as one mile from the windmill. Even at two miles, a horizontal black line will climb slowly upwards from the bottom of the screen. □

Low standards for Advertising Standards Authority

Undoubtedly, the Advertising Standards Authority (ASA) does sterling work protecting the public from the gross excesses of over-enthusiastic hucksters flagging catfood and cornflakes. But the ASA appears to be out of its depth where science and technology are concerned. And it admits to requiring substantially less evidence for the claims it makes in its own press statements than it requires from advertisers to back up their claims.

The saga began when Adrian Hope, a regular contributor to *New Scientist* and various audio magazines, filed a complaint about a Memorex TV advert. The US tape company showed a wine glass being shattered by Ella Fitzgerald's voice, as recorded on its tape.

In an adjudication published last month, the ASA failed to uphold the complaint because it had "received data from the advertiser which satisfactorily substantiated the claim made with regard to the shattered wine glass".

Although the case is not quite so clear, it is the next statement of the ruling which is really eye-catching: "The authority's independent consultant advised that under certain conditions it is technically possible for the human voice to break a wine glass, and that this feat had been achieved by a singer using no amplification at all."

"I have devoted days to searching the literature and I could never find any reference to this. One day in the library,

The current also changes. As the train accelerates, it draws a large current. At a steady speed, it draws less current. And when it decelerates, its dynamic braking returns power to the system, reversing the direction of the current.

Together, this changing horizontal current loop generates a vertical ultra-low-frequency magnetic field, concentrated predominantly at frequencies below 0.3 Hz. Because a heavily laden train can draw 7 MWatt at 1000 volts DC, the current can be as large as 7000 amps, leading to huge magnetic fields.

The influence on trees is so strong that it can be measured simply by hammering two nails 1 cm into a tree and vertically separated by about 1 m. Linking the nails with a wire run through an amplifier and voltmeter, "it is easy to see Bart's influence," Fraser-Smith reports.

Bart must have a similar effect on people. "The human body is an electric-

ally conducting fluid—just a big sack of salty water. A fluctuating magnetic field in a conducting fluid sets up electric currents." Furthermore, cells have their own electric field which would be affected by a varying electromagnetic field.

Direct electromagnetic effects—especially long-term effects—of slowly varying fields seem to be little studied, Fraser-Smith comments. He does, however cite a study now underway sponsored by the Electric Power Research Institute of Palo Alto, California, on the effect of high voltage power transmission line fields on pigs. But most concern is with microwaves and direct heating effects.

There is a danger, he argues, that the large electromagnetic signals now being added to our environment may generate currents in the body which have long-term disruptive effects. "No one monitors our total exposure to electromagnetic fields (of all frequencies) and it is conceivable that the Bart signals, although probably harmless themselves, may increase the possibility of harm from other electromagnetic signals."

Fraser-Smith has been recording geomagnetism for a number of years. Starting in 1972, however, these signals began to be affected by ultra-low-frequency interference. "The signals were a damn nuisance and we tried our best to ignore them," he said. But by 1975, they com-

pleted. "A man I trust told me a man he trusts has seen it happen," Tomson said. Would this be acceptable evidence from an advertiser to back up a claim? "Certainly not," declared Tomson.

We wonder how much the consultant was paid for that major research effort. And Hope asks: "How many past ASA conclusions have been based on equally questionable data?"

Nor is Hope particularly satisfied with the ruling itself. As noted in *New Scientist* last year (vol 72, p 693), Memorex did use Ella's voice to shatter the glass, but at an ear-splitting 146 dB. This is 10 dB greater than the maximum level to which human ears should ever be exposed and close to the level that causes damage to other parts of the body. "You're in the area of mixing cement with sound waves—something which is actually done in the US. This is hardly the domestic set-up shown in the ad," Hope notes.

He said he would not object if the exaggerations were really humorous, as in the Heineken adverts. And "your hi fi nut knows perfectly well that this is irrelevant. But these ads are aimed at the person with a cheap portable tape deck".

Hope suggests that this is just the beginning. Following this ruling, electric light bulbs can be advertised as unusually bright based on tests using extra voltage. Cars will perform miracles on aviation spirit, gramophone records played in a vacuum will not collect dust due to static, and running shoes worn on the Moon will produce new high jump records. □



I even met someone else looking for the same thing," Hope said.

Had the consultant actually done a test? Or had he found documentation that finally gave substance to the folklore about the great Caruso?

After six weeks of hedging, ASA secretary Peter Tomson finally admitted that "the evidence is purely hearsay." Preserving the confidence of the consultant, Tomson would only say that the consultant had talked to an unnamed colleague at an Audio Engineering Society meeting who said he had seen a singer shatter a



OK wise guy—what do we do when the underground stops?

pletely dominated natural activity. And they had the curious property of occurring only five days a week and for only 20 hours of the day.

Clearly the signals were human in origin, and at first it was assumed that they were caused by the Stanford Linear Accelerator (SLAC) which was also on campus. So the detector was moved across the mountain to La Honda, 14 km away.

This failed, so the detector was moved to a hillside overlooking Fremont, 27 km away across San Francisco Bay. Here the signals were even stronger and one of the experimenters, D. B. Coates, noticed that the signal peaks corresponded to the

Are postgrads just cheap labour?

Postgraduate students often suspect that they are viewed merely as a source of cheap labour. But the point is rarely made so explicit as in a leaflet published by the University of Stirling and The Scottish Marine Biological Association (SMBA).

"Stirling postgraduate students stationed at Oban also benefit the SMBA since they increase the number of research personnel. The addition of a student to a project invariably increases research productivity. Although some

arrival and departure of Bart trains into the Fremont terminal just below him.

Brief checking showed that the interference corresponded to the 20 hours-a-day, five-days-a-week operation of Bart. On weekends, when there are no scheduled trains, the system even detects

Doctors back legal laetrile

The suggestion by the prestigious *New England Journal of Medicine* (NEJM) that laetrile—the controversial cancer drug made from apricot stones—should be legalised drew the inevitable outraged letters from doctors. But it also elicited surprising support.

In a leader, *NEJM* editor emeritus Dr Franz Ingelfinger declared that laetrile is a "useless quack cure" (*NEJM*, vol 296, p 1167; *New Scientist*, 30 June, p 766). But he also argued that if a patient with hopelessly advanced cancer "asked for laetrile, I should like to be able to give the substance to him to assuage his mental anguish, just as I would give him morphine without stint to relieve his physical suffering".

He also argued that banning laetrile only encourages its use: "Forbidden fruits are mighty tasty, and especially to those who hope that a bite may be life-giving." Instead, detailed records of its use should be kept and published to prove laetrile's uselessness.

The majority of letters to *NEJM* backed Ingelfinger. One, published two weeks ago (vol 297, p 218), came from Dr Charles Craddock of the University of California, Los Angeles. The problem, he notes, is that not only has the public been sold on the curability of cancer, so have doctors. This means that "experienced physicians, faced with an obvious downward progression of cancer that has not benefited from the 'latest' or the 'hottest', will employ modest amounts of this or that agent". The effect, he argues, is little different from using laetrile—it does neither harm nor good and preserves the confidence of both patient and family in the physician.

Dr Donna Thompson of Portland, Maine, suggests that "laetrilomania" is just another example of the assumption by most Americans that someone will discover a miracle answer to cancer, the energy crisis, and any other problem. Only by making laetrile legal will it be shown not to be a panacea. □

individual trains being moved about yards for maintenance.

Indeed, Bart is now such a large generator of ULF waves the Fraser-Smith proposes to use the signals to probe the ionosphere, the structure of the ground, and perhaps even earthquake faults. □

postgrad, because there are virtually no jobs in marine biology. Those who do get jobs mainly go to Africa.

Not that the postgrad feels there should be much job demand. "Much of the work is non-essential. It isn't economic, it's just scientifically interesting. The sort of research needed for, say, fish farming is much more basic and could be done on a limited budget."

It is cruel and immoral to encourage students merely to provide cheap labour and fresh ideas, the student argues. It would be far kinder in the long run to take fewer students. □

Carter sees a UFO —or does he

Jimmy Carter may have gained numerous "fringe" votes during his presidential campaign with his timely revelation that he had once seen a UFO. But the true story, as now revealed by UFO researcher Robert Sheaffer, would have raised doubts about his reliability.

Carter in 1973 sent a handwritten report to the International UFO Bureau in Oklahoma City describing the sighting which, he said, had been made in October 1969. According to the report he saw the UFO low in the western evening sky in Leary, Georgia, where he was attending the local chapter of the Lion's Club.

Sheaffer found from Lion's Club records that Carter's visit had been on 6 January, 1969, not in October as he had recalled. On that date, Venus appeared

brightly in the south-western sky where Carter would have easily seen it. Of course, Venus is not as bright as the Moon, nor does it approach and recede—but such fanciful descriptions are typical of the misidentification of Venus.

Carter claimed in his report that 10 witnesses had seen the UFO with him, but Sheaffer could find only one who remembered the incident, the 1969 Leary Lion's Club president, Fred Hart—and even he was clearly not impressed. Hart said he vaguely recalled standing outside with Carter watching a light in the sky, but did not regard it as anything unusual.

"Several errors of observation within Mr Carter's report demonstrate that the eye-witness testimony of even a future president of the United States cannot be taken at face value when investigating UFO sightings," says Sheaffer in the July/August issue of *The Humanist*. □

Paying for press coverage

"Fringe benefits" rarely reach scientists, as is confirmed by the experience of one group of researchers at the Science Research Council. The scientists had to pay for the privilege of eating with the journalists who had come to view their new laboratory. When the Rutherford Laboratory held a press preview of its new laser research facility, there was a huffy lunch after the event. And the scientists who had shown the journalists around the new laboratory joined the lunch; but they did so knowing that they would be charged for their meals. At 50 pence the lunch was a bargain—there was even a glass of wine thrown in—but when ICI is talking of contributing magnificently to the cost of educating senior employees' children one would have thought that the SRC could show a little generosity to its scientists. □

In person

Geneticist at large

While working at the frontiers of knowledge, Walter Bodmer has also been conspicuous for his involvement in public discussion about science. Sally Festing interviewed him.

There are people who, by almost uncanny good fortune, seem always to have been in the right place at the right time. For Walter Bodmer, working with R. A. Fisher at Cambridge and Joshua Lederberg at Stanford University could scarcely have been more auspicious. But a successful career is seldom based on happy coincidence or fortuitous contacts alone. The secret lies in having the ability, foresight, and enthusiasm to exploit opportunities fully when they come along.

A recent series of radio talks by Bodmer— at 41, now Professor of Genetics at Oxford—gave me the impression that far from being a cloistered academic, he is someone with broad interests, active in debates about modern social problems and community affairs. Yes, he is at home discussing his ideas, informal and relaxed. Yet it is his standing as a scientist that gives him the authority to air these views.

The third son of a German Jewish doctor whose research was curtailed by anti-semitism, Bodmer arrived in England when he was two. Six years later he joined the preparatory section of Manchester Grammar School, mainly because his brothers were already there. Half way through the senior school he opted for modern languages. Then a teacher advised him to take mathematics in the 6th form because he was "adequate" and there was more chance of an Oxbridge scholarship. After securing one, he went up to read maths at Clare College, Cambridge.

Bodmer is now working in human genetics where presumably a medical background would have been an asset. Why, then, in retrospect, did he not take medicine? "At that stage I just drifted along. I was always interested in biology though I had virtually none at school. I think ultimately I was influenced by my father. He was the first person to discuss biology with me".

"There is little printed science until it hits the headlines..."

At Cambridge a statistics course run by David Cox, now Professor of Statistics at Imperial College, London, stimulated Walter Bodmer to take a statistics option in part III, and the natural concomitant was genetics. "As preparatory reading I got hold of Srb and Owen's textbook on genetics. It was a new world and I very quickly became interested."

Graduation year was also celebrated by marriage to his school-day girl friend, sparking off more than 20 years of collaboration at home and at work. "I was still 20, so my father had to sign the marriage certificate.

Julia was at the High School when I was at Manchester Grammar. She did PPE at Lady Margaret Hall, Oxford when I was at Cambridge and after we married she worked as research assistant for Professor William Reddaway. Since then she has become a geneticist." Today husband and wife work side by side in the same department.

After graduation Bodmer received an ARC student scholarship to remain with R. A. Fisher to take a doctorate. Fisher was not his formal supervisor, but it was Fisher's guiding light over the next few years, his respect for science's exacting methodology combined with insight into biological problems, that left a permanent impression on Bodmer. "He was one of the greatest scientists of this century. I've not met anyone of quite the same stature. My PhD was a mixture of theoretical and experimental work. Fisher insisted I got data for myself, maintained contact with biological material and ran a research project." He worked on the genetics of the mouse and of homostyles in pin and thurneleyed primrose populations—catching up, meanwhile on basic biology.

Then in 1961 the Bodmers cut ties with Cambridge and left for Stanford. "Just as the grand European tour was once fashionable, the States was the obvious place for postdoctorate training. I learned a bit of biochemical genetics before I left, with six weeks at Guido Pontecorvo's laboratory in Glasgow and was already interested in somatic cell genetics so I wanted to study molecular biology with Lederberg, then professor and head of the genetics department in the Medical School. They were pioneering years for studies on the mechanism of uptake of DNA by bacteria and we started research on DNA transformation in *Bacillus subtilis*."

Bodmer is in an ideal position to compare American graduate training with its more loosely structured British equivalent. "Americans need more course work because their first degree standard is lower, or at least less specialised. Opportunities for learning basic information do exist here and post-graduate students should go to relevant lectures and seminars. But I'm not in favour of formalising our system any more. It kills a research interest if students are not allowed to get down to it soon enough. And they learn a lot from working together; this is mutually stimulating. Our contacts with the medical school are very good and I believe that what you learn in one area can be used in another. Some of the best scientific contributions are made through such interdisciplinary applications."

After nine happy years at Stanford, making many friends and enjoying the stimulating



"Our contacts with the medical school are very good and I believe that what you learn in one area can be used in another . . ."



RIC GARNETT

atmosphere of the university, Bodmer was offered a plum job back in Britain—the chair at Oxford. He returned, finally branching out from quantitative genetics into immunology. Recently the HLA system has been shown to be associated with a number of important diseases such as multiple sclerosis and rheumatoid arthritis. By identifying tissue types, it may even be possible to understand people's susceptibility to a whole range of hitherto baffling conditions.

So Bodmer has worked in several different though related fields, often finding that knowledge accumulated in one has elucidated another. In population genetics he was interpreting genetic variation, especially the interaction between selection and linkage, which turned out to be important in the immunological work. In molecular genetics, at a time when little had been done on the subject, his main concern was understanding how bacterial DNA can be incorporated into a host cell. And the HLA work—initially a matter of interpreting data—has led to a huge speculative field within the realms of biomedicine. Meanwhile his work on somatic cell genetics or the study of genetics in isolated, cultured cells, once again links up

with the HLA system.

Walter Bodmer has also emerged as someone prepared to speak openly about his views. Scientists, he believes, have a real contribution to make to a society that is not sufficiently analytical in its approach to problems. "The way to work is to make organised, rational investigations; gather available evidence; construct models and use them in a predictive way; and do experiments to test the validity of one's conclusions. If more social scientists were trained in the hard sciences, they could apply these methods."

By the time he had written his first book with L. L. Cavalli-Sforza, a standard textbook on *The Genetics of Human Populations* (1971), he was already involved in the contentious world of political and racial issues. They took a stand in the argument over William Shockley and Arthur Jensen's publicly expressed belief that American blacks are intellectually less able than whites, and that this was due to genetic factors. Both current techniques and the data available for testing results, they believed, were inadequate. Besides, the question was irrelevant in a society that professed to be free of racial prejudice.

"Assessing the inheritance of intellectual ability depends on complex statistical analyses which are used to sort out the relative contributions of heredity and environment. It's very hard to separate out these effects. Nevertheless, nearly all studies have come up, to a greater or lesser extent, with strong evidence for a significant inherited component to IQ differences. The correct view is certainly that what is inherited determines the mode of response to the environment. No attribute, whether intelligence, or susceptibility to an infectious disease, is free from both genetic and environmental influences."

Since 1971 Bodmer has chaired the British Association's Committee on Social Concern and Biological Advances, and in 1974 he and Dr Alan Jones summarised the group's discussions on a range of social topics with ethical, legal and scientific implications in the book *Our Future Inheritance—Choice Or Chance?* Facts on such issues as artificial insemination, selective abortion, genetic engineering and organ transplantation were presented by an informed group of scientists, doctors, lawyers, theologians, social scientists and MP's, then a systematic application to the problems was made—a perfect illustration of the way Bodmer believes such issues should be tackled. He has a deep respect for the value of personal communication. "It was probably the first time Shirley Williams and David Owen (who were also on the committee) really heard about genetic engineering."

The group has gone on to consider problems of retirement policy and job structure in an ageing population, with the intention, eventually, of publishing a book that makes specific recommendation on the sort of research they feel is relevant. "Now that at least 80 per cent of the population survives to the age of 60 and about 30 per cent to 80, does it really make sense to assume that people should have one and the same job until suddenly, when they get to 60 or 65, they stop? They may be left with another 10 or 20 years of physically and mentally active life."

With a geneticist's knowledge that people are infinitely variable, that each one is unique, he believes a fitting education is one that caters for individual talent. He deplores current financial restrictions in education and the tendency for teaching methods to be governed by fashion.

Professor Bodmer also participated in the BA's study group set up to explore the issues involved in communicating scientific knowledge, which produced the report *Science and the Media*. "There is a problem in that the scientist is not trained to put his ideas over in a simple way. On one hand there is the danger of seeking attention, on the other, there is far too little rapport with the media—too few opportunities for journalist and scientist to get together. There is little printed coverage of science unless it hits the headlines. It's just not on the agenda for most papers."

By and large, Bodmer thinks written material compares badly with radio and tele-

vision reporting. He says of a BBC Science consultative group to which he belongs: "We meet two or three times a year, bringing groups of scientists together with producers. A good rapport develops. The BBC are not under the same pressure as papers to dramatise." In contrast, he is frequently irritated and appalled by what he reads in the press: "So much is biased, so much is sensational and misrepresented." *New Scientist* sometimes sends him hopping mad: "Roger Lewin's report (17 March) of the National Academy of Science Forum on genetic engineering, for example, concentrated disproportionately on the 'opposition' to this new type of research. The *Horizon* film at about the same time on the same subject was much more balanced." At the same time he believes implicitly in the importance of public discussion of science. "I've never refused to talk to a reporter who has phoned me up about something."

Another of his concerns is the internationalisation in government departments, which ignores vital specialist knowledge. "Too many decisions are made without contributions from outsiders yet they are in a position to understand technical issues. If you are trained as an administrator you won't have specific knowledge and you need assistance from people who do." Apart from the value of outsiders' contributions, Bodmer feels they lend a healthy balance to policymaking. "There's too much secrecy around. We need to be much more open in our decision making. It is disturbing that in any given, even limited, area it can be difficult to find out who is doing what and why. I wonder sometimes whether those within government departments are really that much more in the picture. For example, does the University Grants Committee have to keep secret the formula on which it allocates funds to the Universities? I don't see why. A major contribution would be much greater openness."

"We need to be much more open in our decision-making . . ."

Despite Bodmer's political involvements, he is first a scientist, most committed to and taking greatest pleasure in science itself: "It's important to spend a proportion of time in other fields but science is what we find really exciting." A major activity at the moment is organising a HLA workshop—a mammoth international collaboration to facilitate exchange of reagents and of ideas—to be held later this year. He calls it a "mini United Nations". "We've divided the world into 18 regions. There are more than 150 laboratories participating, coming from 30 countries, every continent except Antarctica."

Throughout our interview Walter Bodmer used the word "we". If he, in the past, has benefited from cooperation with other scientists, he feels a loyalty towards those who work with him now. At a time when faith in communication might seem to waver, he is a firm believer in the benefits of mutual assistance and teamwork—key qualities in the scientific enterprise. □



Founding fathers of science education The Benjamin of studies

The origins of science education reflect the diversity of needs and interests of a class differentiated society. In this the first of a series on the Founding Fathers of Science Education, the convenor of the series explores the diversity of interests in 19th century Britain

David Layton
is professor of science education at the Centre for Studies in Science Education at the University of Leeds

As a core subject in the school curriculum, science is a relative newcomer. The traditional dominance of classics and mathematics in secondary education, and of biblical knowledge and the three Rs in elementary education, yielded

slowly. Indeed, the long-overdue incorporation of science into education provoked Sir Bernhard Samuelson, the 19th century industrialist, to designate it "the Benjamin of studies". Benjamin, it will be recalled, was the belated child of Jacob's old age. Prudently, Samuelson refrained from mentioning that Benjamin's mother, Rachel, had died at his delivery, and that Jacob's death-bed prophecy was that "Benjamin shall ravin as a wolf".

By the opening of the 20th century, science had indeed made substantial curricular gains. Through the tradesman's entrance to the house of learning, under the regulations of the Department of Science and Art, the invasion of science instruction into secondary education had been accomplished. Schools of science, earning payment by examination results, had been established in higher grade schools, endowed secondary schools and technical institutes. The Technical Instruction Committees of local authorities, called into being by the Technical Instruction Act of 1887, and armed, after 1890, with increasing sums of "whiskey money", had supported the developments; between 1880 and 1902 the number of chemical laboratories in such schools increased from 133 to 758 and some 300 physics laboratories had come into being. Under the seal of the 1904 Regulations for Secondary Schools science was ensured a secure place within the newly municipalised secondary schools of England and Wales. Commenting on this situation, *Nature* proclaimed to its readers that "We are promised exactly that for which men of science have frequently and consistently pleaded".

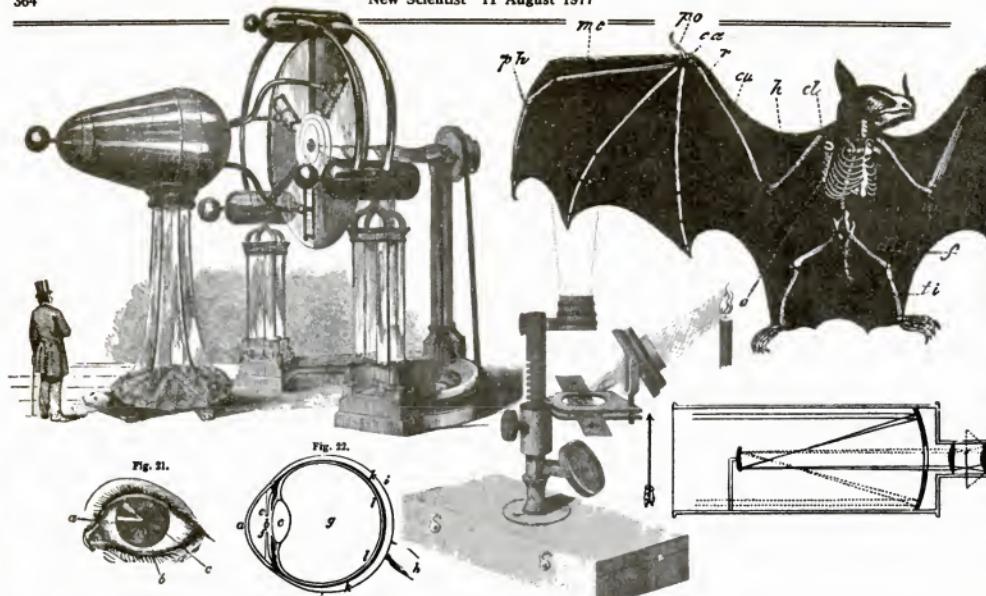
Within the great public schools, improvements had also

taken place, albeit slowly. By the early 20th century most had at least one chemical and one physical laboratory. Outstanding individuals, like Worthington at Clifton College, Bristol, had pioneered curriculum innovations such as the teaching of physics through individual practical work. In 1900 the first enduring association of science teachers had come into being, the Association of Public School Science Masters, forerunner of our present-day Association for Science Education.

Turning to the elementary schools, the fortunes of science in the curriculum had fluctuated dramatically. Around the mid-century, and in the wake of the Great Exhibition of 1851, there had been high points when the science of common things was the focus of a national curriculum development programme. Inspired by the achievements of Richard Dawes in his school at King's Somborne, Hampshire, and directed by Henry Moseley, FRS (Britain's first scientific inspector of schools and training colleges) the movement was in advance of its time. Remarkable results were also achieved in the teaching of elementary botany by J. S. Henslow, professor of botany at Cambridge and Darwin's mentor, in his village school at Hitcham, Suffolk. With re-trenchment after the revised code of 1861, science for a while disappeared from the elementary school curriculum, emerging again towards the end of the century, occasionally as mechanics, or animal physiology, but more often as nature study and lessons on "objects".

Commitment to individualism

Within the bounds of formal scholastic provision, then, science may be said to have acquired a secure position by the early 20th century. The educational endeavours of scientists such as T. H. Huxley, H. E. Roscoe and H. E. Armstrong, each of whom had pressed the mental training claims of their subject, had not been in vain. Nevertheless, an observer, surveying developments over the 19th century, cannot help but be struck by significant differences in



varieties and styles of science education between the beginning and end of that period.

Apart from a highly differentiated class structure, the outstanding characteristic of the social context of science education in the early 19th century was a commitment to individualism, voluntarism and self-help. Anything smacking of state intervention or central control was regarded with suspicion, if not downright hostility. The prevailing creed was one whereby initiatives and support should arise at grass-root level by the exercise of individual powers of choice and action. Direct financial aid and stimulus from the centre was seen as likely to weaken local effort and undermine private initiative. According to the doctrine of *laissez faire*, if scientific knowledge were demanded by society, then those institutions and individuals proferring it would prosper. Equally, if what was supplied did not meet a demand, it would wither away from lack of support.

Within this context there emerged a rich variety of institutions and agencies concerned, in varying degrees, with the diffusion of scientific knowledge. The styles and traditions of science education were forged in them, acquiring status and legitimacy as varieties were matched to institutions.

One strongly delineated tradition with roots traceable at least to the 17th century was characterised by the "holy alliance" of science and religion. Scientific knowledge was pursued because it could be made to sustain beliefs in "the Power, Wisdom and Goodness of God". The eight Bridgewater treatises, commissioned under the will of the 8th Earl in 1829, and all but one written by fellows of the Royal Society, exemplified the genre. If harmony between the worlds of revelation and of nature could be demonstrated, then hopefully this might lead to increased stability at the level of individual values. As Margaret Bryan, the proprietress of a celebrated London school for young ladies, recorded in the preface to her *Lectures on Natural Philosophy* (1806), scientific knowledge armed her pupils with "a perpetual talisman" by means of which they might guard their "religious and moral principles against all

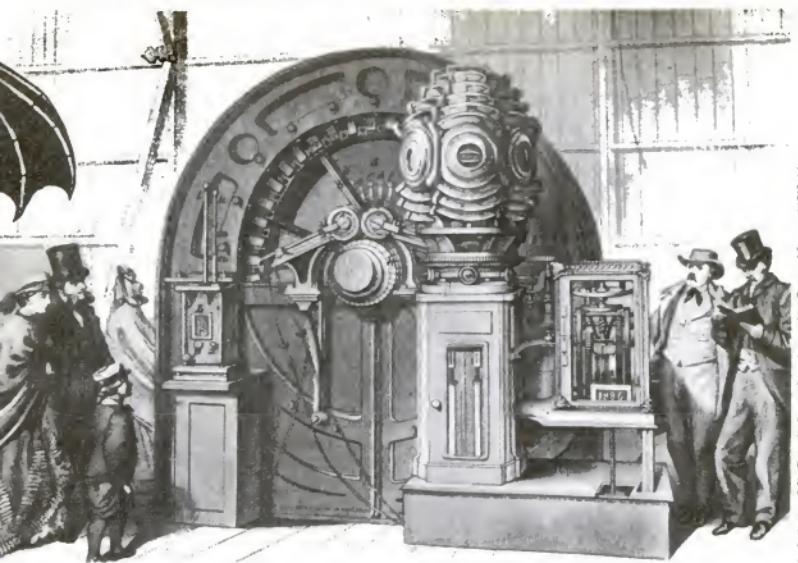
innovations".

Simultaneously, in the wake of the French revolution, there were others who saw in scientific knowledge a potential instrument of political independence and intellectual emancipation. Men like Rowland Detroisier and Richard Carlile lectured on science and advocated its wider diffusion in order to dispel superstition and undermine dogma. Carlile's *Address to Men of Science* (1821), written from Dorchester gaol, cast science in the role of an agent of social and political reform; change rather than stability was the end in view.

Whether in mechanics institutes, philosophical societies and similar associations, or in the home, scientific knowledge was sought to a remarkable degree in the 1820s and 1830s. "The sacred thirst for science is becoming epidemic," the *Edinburgh Review* commented. Not all those who thirsted, however, had religious or political motivations. For a considerable regiment of audodidacts—baker-botanists, weaver-astronomers, saddler-opticians—as well as for the new men of urban, industrial Britain, science would appear to have been cultivated because it dignified their existence, offering a form of culture which corresponded to their way of experiencing the world and affirming their values, being progressive, egalitarian, empirical and down-to-earth. "He who cultivates any department of science can claim kindred with the master spirits of the world", a contemporary voice maintained.

Knowledge for lower orders

The uncontrolled diffusion of knowledge, and of scientific knowledge in particular, to the "lower orders" was an issue which provoked much comment. Henry Brougham's *Practical Observations upon the Education of the People* (1825) and the activities of his Society for the Diffusion of Useful Knowledge were criticised because, in the words of one writer, "A scientific education to the working classes . . . will derange the base of society . . . any alteration there, will level the superstructure with the dust". Against this, it was argued that a well-constructed system of national



From 'The Circle of Science' 1862-63

"Ten-feet Glass Plate Electrical Machine", the eye and its structure, a compound microscope and Gregorian telescope, a skeleton of a bat, and "Holmes' Magneto-Electric Light Apparatus" (Exhibited in the International Exhibition, 1862)

education might offer a solution to the problems of working-class crime, improvidence and immorality. Schools might be justified in terms of their contribution to the socialisation of the lower orders. In 1833, the first government grant in aid of elementary education was made, and when in 1839 a Committee of Council on Education, with an inspectorate, was established to supervise the grant, the first steps away from individualism, towards collectivism and central control of the curriculum, had been taken.

Additionally, from the mid-century onwards, increasing attention was directed to scientific knowledge as a source of economic benefits. "As surely as darkness follows the setting of the sun," Lyon Playfair warned in 1851, "so surely will England recede as a manufacturing nation, unless her industrial populations become more conversant with science than they are now." Two years later, state intervention brought into being a Department of Science and Art, under the Board of Trade, responsible for the scientific education of the artisan class. Eventually the studies which the new department examined were to include metallurgy, steam, nautical astronomy, building construction, navigation and principles of mining, as well as more traditional branches of physical and biological science. The conception of applied science stopped short of workshop practice, however. As one of the department's officials explained in 1867, "It would be scarcely possible to devise a more effectual blow to the manufacturers of a place than for the state to establish a real technical school, with its workshop, under no constraint to pay its expenses, under-selling them and interfering with their market."

An evaluation of scientific knowledge in terms of its industrial applicability was not one which commanded universal assent, however. Not surprisingly, an opposing view was burnished by the scientific community; for the Royal Society and the British Association for the Advancement of Science, science was conceived primarily in terms of the disinterested pursuit of truth; the encouragement of abstract science was the sovereign good, and, implicitly at least, science teaching had as its main purposes the supply of

future proficients and the creation of a favourable climate for their activities. Allied to a view of education in terms of the training of mental faculties, this conception of science education, as pure, abstract and socially disconnected, was to be extremely influential in the public and endowed secondary grammar schools.

At least for some pioneering educators associated with elementary schools for the great mass of the population a different conception prevailed. Scientific knowledge was here used selectively as an educational resource, in order to aid children in the development of rational modes of thought and of greater control over their physical environments. The precise selection was to be related to the social backgrounds of the children in question; thus, applied physical sciences, such as elementary mechanics and agricultural chemistry, were allocated a central place in the curriculum of the children of agricultural labourers; there would be one physics for princes, and another for paupers.

Throughout the early and middle years of the 19th century many such varieties of science education were to be observed, the products of individualism operating in a class differentiated society. Scientific knowledge fulfilled a plurality of social roles. By the turn of the century, uniformity rather than variety had become the outstanding characteristic, with science pursued, like classics, as a rigorous means of mental training. It is tempting to draw an evolutionary analogy, and see the early varieties as species competing for survival in an educational environment which, with increasing state intervention and the institutionalisation of educational concern, was becoming progressively more sharply defined. Educational environments do not remain constant, however, and are under the control of man. Today, when the agenda for the national debate on education includes questions about the functions of school science, it is perhaps worth looking again at those who assisted science in its environmental adaptation and at some of the species which they cultivated. □

Next week: Henry Moseley FRS (1861-72), Britain's first science HMI and architect of our national curriculum reform.

Review

The Russians

by Hedrick Smith
Sphere, £1.50

Hedrick Smith has succeeded in packing into his book much revealing and interesting information on life in the Soviet Union. He spent three years in Moscow as correspondent of the *New York Times*, and seems to have been able to make direct contact with many individuals from all walks of life. Although what he has to write about will not provide any startling revelations to readers who keep their ears close to the Soviet scene, Smith writes well and the detail and mass of information he has succeeded in collecting—always trying to get behind the front facade—makes for fascinating reading.

The book is divided into three parts on "The People", "The System" and "Issues", each one subdivided again into chapters. There is no one section dealing with science or technology as such, but many aspects of the book are relevant.

He describes the privileged classes—of which the top scientists are certainly a part—with their own dachas and perks within the pecking order of Soviet hierarchy. In talking of agriculture, Smith mentions a little known experiment to link up small groups of agricultural workers to be responsible for one area of land, much in the same way that they are responsible for their small but highly productive private plots. The scheme lasted only one year. After proving that he was right and the whole agricultural leadership was wrong—the scheme increased productivity 20 times—the innovator was jailed for six years, on a trumped up charge. There are also interesting chapters on industry and education.

Smith discusses the problem of information, which bugs many Soviet scientists. He cites a mathematician who described how it took Soviet scientists nearly six months to confirm the discovery of the psi-meson in 1974, when it took only a couple of days for West German and Italian scientists to repeat the experiments of their American colleagues. There is also the amazing story of an enormous forest fire that broke out in the summer of 1972. It needed

more than 1000 firefighters, including planes, paratroopers and military units, to bring it under control and it approached within 15 miles of the centre of Moscow. Despite a blue haze which hung over Moscow for days, the press printed hardly anything about this fire, and *Pravda* said not one word. It is when you read of situations like that, you begin to understand how it is possible for serious nuclear accidents to be unknown to the mass of the Soviet population.

Sarah White

Inside the animal world

by Maurice and Robert Burton
Macmillan, £6.95

I know no subject more elusive, more difficult to put into context, than that of animal behaviour. There are snippets of folk lore that (as with the "anting" of birds) disconcertingly often turn out to be true and demand explanation; it seems unsafe to write off even the most outlandish travellers' tales. There are experiments that, in the interests of rigour, have to be so contrived that they cease to relate to the real world but have, none the less (as with Pavlov's description of reflexes), given rise to unshakeable schools of thought and universal explanations of all activity. The gap between the things that can be studied and the thing one would really like to know (what "thoughts" and feelings underlie behaviour?) is inevitably unbridgeable; and in their anxiety to avoid mysticism, and the dread beguiling spectre of "anthropomorphism", too many writers in the past have apparently been afraid even to think of their subjects as animate.

In *Inside the Animal World*, Maurice and Robert Burton avoid such pitfalls. They describe dispassionately what animals are known to do (and also what they have occasionally been reported to do) and, equally dispassionately, the hypotheses that attach to that behaviour. As zoologists, though, they never lose sight of what seems to me the crucial fact, that the objects of study are our fellow creatures, real live sentient beings scratching a living in a complicated world. That is the modern synthesis: scientifically rigorous, but without the (unscientific) arrogance which

assumes that what cannot easily be measured does not exist.

The book begins with a generous overview: schools of ethology, American and European; reflex, stimulus and response, and the rest. Then follows a chapter of sensors and effectors, the instruments of behaviour. The authors devote nine chapters to each life activity in turn—eating and drinking, holding territory, reproduction—and conclude with essays on unusual and aberrant behaviour (like overkill, autophagy, cannibalism) and on unsolved problems.

By bringing order to an untidy subject this book will be useful for students and teachers, and should prove a worthwhile read for anyone.

Colin Tudge

Plant life

by C. T. Prime

Rocks

by D. Dineley

Insect life

by M. Tweedie

Collins Countryside Series,

£2.50 each

With Collins' reputation as publishers of natural history books of the highest order the three recent titles in their "Countryside" series come as a disappointment. Intended to offer the beginner a modern introduction to British natural history, they fail to provide anything that is not already well catered for elsewhere, in indeed in two of the cases by the same publishing house.

All are lavishly illustrated with plates and line diagrams but nowhere in the texts are any of the former specifically referred to. The diagrams are well executed but at times lack adequate labelling or explanations.

In *Plant Life*, C. T. Prime takes a limited view of the vegetable kingdom, with algae, fungi and bryophytes receiving little or no mention. He touches on various aspects of the ecology and identification of higher plants but although much of the text is of interest it occasionally reads oddly.

This book does, however, deal with the subject as a field science which is certainly not so with David Dineley's *Rocks*. Excellent though it may be as a theoretical text for first-year undergraduates it is far from

suitable for the uninformed layman addressed in the series' preface. The reader is taken through a catalogue of mineral types, crystal systems and details of igneous petrology, but he will find little to help him interpret his immediate surroundings. Most of us live on sedimentary rocks but they have only one chapter devoted to them and nowhere are geological maps or field guides even mentioned. The chapter on the major fossil groups is condensed beyond the point of usefulness and yet space is given to aspects of rock structure only visible in thin section and with the aid of a microscope.

Best of the three is Michael Tweedie's book *Insect Life*. Many gems are contained here but why with our vast wealth of native insects must so many of the examples be exotic? His plea for a greater appreciation and understanding of this class is timely, but if he hopes to send individuals down the road to wisdom the perpetuation of such basic misconceptions as equating respiration solely with gaseous exchange cannot help.

Tim Oldham

Cosmology +1

edited by Owen Gingerich

Freeman £6.80 hb £3.50 ppb

The latest in the popular collections of articles from *Scientific American* deals with various aspects of astrophysics, from the expansion of the Universe (by Sandage), the curvature of space (Gamow, and J. J. Callahan), and the cosmic background radiation (Adrian Webster), via quasars and galaxies (contributions from Scrimge, Schmidt and Bello, and Rees and Silk), to the search for black holes (Kip Thorne) and Stephen Hawking on exploding black holes. Perhaps most fascinating of all is the question: will the universe expand forever? answered in the affirmative by Gott, Gunn, Schramm, and Tinsley. Some of these articles have already been collected in the *Scientific American Frontiers of Astronomy* books, so beware. The "+1" of the title refers to an article by Carl Sagan and Frank Drake on the search for extraterrestrial intelligence. Its inclusion is a genuflection to a fashionable topic that is even more speculative than most cosmology.

Ian Ridpath

Bookwatch briefs

Current R&D projects in Israel, 1975 (Vol. I Tables, Vol. II Indexes), by N. Goldenberg and P. Wollman (National Centre of Scientific and Technological Information, \$60 each). These weighty tomes give a comprehensive listing of over 10 000 research projects under way in Israel in 1975. You can find out what's being done in organosulphur chemistry, who is doing it, and where they are working. A keyword index provides a useful fine filter for subjects. The seven entries under War and Wartime are divided by a reference to Warbler population dynamics. J.M.

Energy, environment, populations and food, by G. L. Tye (Wiley £11.00), is written mainly about and for Americans but its general philosophy is also applicable to other nationalities. The theme is familiar, and the text is concise and reinforced by the inclusion of 39 statistical tables, compiled from original sources. The book will be a valuable data fount. Chapters include capacity limits of spaceship Earth; energy technology and energy supplies; food technology and supplies; past ex-

pansion v slow future growth; adjusting to future demands, and US economic expansion 1970-2000. P.J.B.

Radiation effects in semiconductors, edited by N. B. Urli and J. W. Corbett (Institute of Physics Conference Series 31, £22). The semiconductors with enormous theoretical and commercial applications are generating a vast volume of research. The international conference held at Dubrovnik in 1976 attracted 125 participants, and its published proceedings run to over 70 papers.

The lattice defects which make semiconductors work can be caused by impurities, radiation, or a combination of both. The proceedings offer some of the latest data on radiation-induced effects and compare them with results predicted by semiconductor theory. The preparation of germanium with an impurity level of only one part per billion has provided new information about the way hydrogen bonds with lattice vacancies. J.M.

Operation of instruments in adverse environments, edited by J. Knight (Institute of Physics Conference Series 34, £16). Adverse environments in this context can range from an offshore drilling platform in the North Sea to outer

space. The volume presents some new examples of passivation under severe marine conditions. It also describes ways of detecting hot axle boxes, which can cause rail accidents. Other difficult environments are coal mines and advanced gas-cooled reactors. The papers are concise and engineers should be able to gain a perspective of their own problems by studying those of their fellows. J.M.

Coastal ecosystem management, by John R. Clark (Wiley, £28.90), is subtitled "a technical manual for the conservation of coastal zone resources". It has been prepared for those professionally involved in the management of coastal environments. It analyses the various habitats, both natural and man-made, identifies major conflicts, and develops a management methodology. The main text is followed by 41 contributed articles on a range of topics as broad as that of the book—which discusses planning, environmental sciences, marine biology, sanitary engineering, law, oceanography, hydrology and landscape design within a management framework. Being an American text, it relates closely to the Federal Coastal Zone Management Program and US legislation. T.L.

Art

Nicolas Schöffer: Chronos 15

Civic Museum of Art, Bonn,
until 21 August, 1977

The exhibition held just behind the Essex-pink Rococo town-hall is highly topical: it tells the tale of how Schöffer, a native of Hungary and 65-years-old, won the competition for the design of a work of art for the new civic centre.

Schöffer, long an exponent of kinetic art, has edged his way into what Frank Popper has explained as kybernetic art: by interacting with its environment "an aesthetic instrument is . . . transformed into a communicating organ of information and guidance of the urban environment". It is the idea of interaction which justifies the use of the word kybernetic. One of the exhibits consists of arrays of boxes



Chronos 15

which contain up to 15 light bulbs each, and which transilluminate up to four transparencies of random geometrical patterns one on top of the other. By slightly nudging

the base, the public can influence the programmed sequence.

Photographs of Schöffer's ideas for a kybernetic city (with provision for a scientific centre) remind one of the futurist dreams at the beginning of this century: less square than those boxes, the ellipsoid elevations are not on once zero-growth has come to stay. This explains also why the staggering kybernetic Tower of Light, designed to shed light on Paris, is accompanied by a tag with the pathetic caption of "Not realised so far".

However, Chronos 15 is realised. This 20 metre high structure is made of stainless and highly polished steel. It stands on the east side of the above-mentioned civic centre, and, according to one aesthetic soul, fails to fit into the town. Horizontal cross-bars grow out of five uprights at spiralling angles, and support 57 equally bright vertically

MACHINE INTELLIGENCE 8

Machine Representations of Knowledge

Edited by E.W. Eloock,
Professor and Chairman of
Computer Science,
University of Western Ontario,
and D. Michie, Professor of
Machine Intelligence,
University of Edinburgh.

Machine Intelligence 8 offers a compact account of recent advances by leading investigators concerning the important problem of representing human knowledge in formal schemes so that it can be assimilated, manipulated and "understood" by machines. It reviews theoretical and experimental insights in application to mathematical reasoning, deductive problem-solving, knowledge-measurement, inductive learning, computer programming, man-machine dialogue, descriptive methods in empirical science, and the design of seeing and language-understanding machines. Each chapter has been specially commissioned so as to fit into a carefully structured framework of authoritative inter-locking parts. Novel discoveries and trends are set into a solid background of exposition, and related to previous knowledge in such a way as to serve an advanced tutorial function. The combined bibliographies put into the reader's hand the keys to virtually everything which is yet known in this subject.

(Machine Intelligence Series:
Editor-in-Chief: D. Michie)

632 pages May 1977
085312 058 7 \$45.00/£24.00

Published by ELLIS HORWOOD LTD.,
Chichester, and distributed by
John Wiley & Sons Ltd.

JOHN WILEY & SONS LTD.,
Baffins Lane, Chichester,
Sussex PO19 1UD,
England.

Review

continued

pivoted discs, diamonds, squares and rectangles.

At first sight it seems as though their movement is actuated by the not inconsiderable breeze always blowing near tall buildings. But no: both the sense and the speed of revolution of each mobile is programmed independently of the pattern which governs the illumination by 57 projectors in five colours. There is little doubt that, in London, the erection would, by now, be known as the Heinz. The German approach to such matters is more severe, which is not surprising in view of the fact that a fixed percentage of the cost of a public building is applied for its artistic content.

Heinz is kybernetic because microphones enable it to react to environmental noise. That, in any event, was the intention. On purely economic grounds, the idea is "not realised so far". I hope to goodness that the system embodies environmental homeostasis, and that too much noise produces so much light as to reduce the noise and so ad infinitum.

Robert Weale

Audience

Not much sex on television

British television is diffident about sex. On the one hand, programmes and commercials brim over with innuendos and images. Can you imagine the Two Ronnies stripped of their right to make the most obscene double entendres? What would happen to the makers of ads for sleek cars and other up-market goodies if they could not link their product with near-nude young ladies in subtly provocative poses? But the serious treatment of sex makes television and its moguls nervous.

Violence may be full-frontal. But, to judge by the tone of Yorkshire's *Man and Woman*, full frontal sex will not rear its erotic head on British television for decades.

I had better declare my interest. This time last year, Thames TV refused to transmit seven completed one-hour programmes called *Sex in Our Time*. I was one of those who made them. *Sex in Our Time*

was far more sociological than erotic. It tried to see how people's sexual attitudes and behaviour have changed. It had no full frontal nudity and only the slightest view of breasts. It was banned. There was a row with many confused accusations.

In the wake of this row, no one can blame Yorkshire for playing safe with *Man and Woman* which is an adult education series. It consists of six half-hour programmes that are going out at 11.15 pm until 18 August. The producer, Graham Watts, has stuck to two sensible rules to avoid controversy. The programmes deal largely with physiology and, as much as possible, the people who appear are experts. As long as it's academic, it must be safe.

The first programme looked at the state of sex education in Britain. It had one nice idea. It got medical students to talk about what they knew of the facts of life. Precious little before they got to medical school.

The programme might have added that medical schools, in the permissive times, still teach very little about sex therapy,

while GPs often see many patients who suffer because of sexual problems. The programme also showed a class being given a quite relaxed sex education lesson.

The rest of the programme was disappointing. Michael Schofield, who made some pioneering studies of sexual behaviour in the young in the 1960s made a plea for more sex education. Since Schofield is a genuine expert on the sexual behaviour of the young, he might have talked—preferably with some teenagers—about how sexual modes have changed since 1960. Perhaps that would have been too risky.

The programme ended with an animated explanation of what happens to our bodies at puberty. This was clear but, even in diagrammatic form like a medical illustration, the producer felt that he could not show an erect penis whose end was somewhere off-screen. I leave it to Freudians to reckon the trauma that showing a truncated penis on the box might cause.

The second programme covered the physiology of inter-

'Kodak' Publications for the scientific and specialist photographer



One or more of these 'Kodak' Publications could prove an invaluable aid in your specialist photographic work. Each of the publications in this selection has been prepared and illustrated with great care and expertise, hence their considerable reputation as technical guides.

	List Price	Incl. P&P
<i>Applied Infrared Photography</i>	£2.50	£2.86
<i>Kodak Infrared Films</i>	85p	£1.13
<i>Ultraviolet & Fluorescence Photography</i>	£1.80	£2.08
<i>Basic Scientific Photography</i>	£1.00	£1.36
<i>Cinemotomicrography</i>	85p	£1.13
<i>Close-up Photography</i>	£2.40	£2.68
<i>Electron Microscopy & Photography</i>	£1.80	£2.08
<i>Photomicrography</i>	£2.40	£2.76
<i>Kodak Plates & Films for Scientific Photography</i>	£2.00	£2.36
<i>Photomicrography of Metals</i>	£1.00	£1.28

Please send your order, together with Cheque/PO/Money Order to the following:
Patrick Stephens Limited,
Bar Hill, Cambridge CB3 8EL

course. It had Dr John and Dr Judy Bancroft who, in effect, gave a lecture about the research of Masters and Johnson. It was, usually, very competent though they did rather tend to seek refuge in scientific terms like the refractory period—the period after orgasm in which men cannot get a new erection.

Also, they faced a very real problem in not wanting to scare people into thinking that their sexual performance was, somehow, inadequate.

Dr Judy Bancroft rather skated over the issue that many women fail to get orgasms, even if they do not know how

to express their resentment. This failure by the programme seems to me to be quite serious.

In the research for *Sex in Our Time*, we found that many women were really irate at the fact that their husbands understood so little about the female orgasm. Magazines like *Cosmopolitan* and *She* (which hardly reach a more high brow audience than a show at 11-15) thrive on telling women how to achieve better orgasms. *She* has been advertising on Capital Radio its latest issue on the grounds that its article, "Sex and Sensibility", will give men "OUTSPOKEN ADVICE" on

how to be marvellous lovers. But television fears to tread close to such sensibilities.

In being critical in this way, I am not really being critical of the Yorkshire production who faced an impossible dilemma. They went into production as the row over *Sex in Our Time* was in full spate. They must have felt that, if they went "too far" (and, in television terms, almost anything that appears in newspapers or magazines seems too far—so far) their series might not see the air. So their programmes have turned out to be fairly dull, very safe half-hours in which they convey some of the basic

information. But at least they have got them on the air. I believe people would welcome a much franker and freer exploration of sex and sexual attitudes on television.

So, watch the programmes at 11-15 pm. Further programmes cover sexual problems and sexual problems as one grows older. But don't expect to see either anything too thrilling or too interesting. Given that the authorities who control television are clearly unsure about how the medium should look at the serious side of sex, the timidity of *Man and Woman* is no surprise.

David Cohen

Heritage

Scientific serials

"The Commissioners have established a public library of research within the Patent Office, to consist of the scientific and mechanical work of all nations"

Thus reads the report of the Commissioners of Patents for Inventions for 1852-1853, the birth-notice of the library which is now the Holborn half of the Science Reference Library, in London. The mood of the Great Exhibition had persisted. Long overdue reform of our antiquated patent system had just taken place, so the library is coeval with the system and Office in something like its present form. Bennet Woodcroft (1808-1879), professor of machinery at University College, London, deserves most of the credit.

Realising that records are essential to a healthy patent system (he was also an agent) he had privately produced his great *Alphabetical Index of Patentees, 1617-1852*. In 1853 a special act of parliament provided "for the purchase of certain indexes" for which he received £1000. Appointed the first Superintendent of Specifications, Woodcroft organised publication of over 14 000 of them in five years. In the 1859 accounts, £271 is recorded as paid to him for "his collection of books to be provided for the Public Library in the Patent Office".

Here, certainly, was part of the nucleus of the Holborn Branch's present 80 000 monographs. In addition to the patents, the eponymous responsibility of the library, the holding of journals grew from 250 titles in 1861 to nearly 3000 in 1890. The first complaints of an information explosion are heard at this time: "impossible for the working naturalist or physicist to keep track of the rapid growth of scientific serial literature" wrote S. H. Scudder in *Catalogue of Scientific Serials*, 1879.

The present library in Southampton Buildings was completed as part of a rebuilt Patent Office in 1902. By then it housed one of the foremost scientific and technical collections in the country. In the mid-1960s it became the Hol-

born Branch of the National Reference Library of Science and Invention, under the British Museum and then assumed its present name in the reorganisation following the British Library Act of the 1970s.

There were painful problems of transfer or disposal of early material, to make room for expansion in modern science. Many pre-1800 works, including a superb collection of early cookery books, were taken over by the then BM Library. (In turn the latter released important science journals to the SRL.) Early issues of many 19th century technical journals had to be disposed of, but mainstream science journals were not much affected. Most of these, and many other rare works, are now in the Holborn Branch annex off the Aldwych.

A closer look, such as I have taken in recent weeks, at the cost of much craning on steps and bending double between shelves, reveals the

riches acquired by the "POL" in its century and a quarter of life. Pencil notes of sales, bookplates and inscriptions, make it plain that Woodcroft and his successors were assiduous collectors as well as librarians.

A handful of titles, such as the Royal Society's *Philosophical Transactions* and *Miscellanea*, and the Paris Academy's *Histoire et Mémoires*, date from the first century of

Neue philosophische Abhandlungen der bayerischen Akademie der Wissenschaften.



organised science publishing, the 1600s. Of pre-1800 titles there are no fewer than 40, and of pre-1900 between 200 and 300. (The Bayswater Division has over 100 more pre-1900 titles.) They represent the principal science academies of Europe and the New World, and include most of the important series devoted to single sciences. Many early series are still going strong, though identities can be difficult to trace through many changes: Gilbert's, Liebig's and Poggendorf's names disappear from their respective *Annalen*. The offspring of *Miscellanea Berolinensis* is the *Abhandlungen*

of the Deutsche Akademie der Wissenschaften zu Berlin.

The shelves reveal the relative intensity of scientific work at different periods, such as the special interest in agriculture of the late 18th century, or the rapid progress of chemistry in the 19th. I found some important if shortlived independent journals, such as *Chemische Journal für die Freunde der Naturlehre* (1778-1806)—who would dare such a title today!—of Crell, Lorenz, not to be confused with the later Leopold Crell. Sometimes the shelves can put the authorities right, as when what is often cited as Berzelius's *Jahresbericht über die Fortschritte der Physischen Wissenschaft* (1882) reveals itself as Wöhler's Tübingen translation of the master's reports to the Academy in Stockholm. (The library has the French edition too.)

The Patents Bill now, well on its way to the Statute book, may increase the relevance of this heritage of material. All published work, not, as formerly, that of only the past 50 years, may contribute to defining the state of an art. At a less pragmatic level, science journals do not (I find) go flat, like vintage wine if kept too long. Science in the past was often a less specialised activity, and the subject range of journals was wider in consequence. Yesterday's science is part of history, its relationship to philosophy, society or art may be clearer now than when it was published. There are also the great moments: Newton on colour, Davy on electricity in nature, Clerk Maxwell on matter and energy, when our view of the world is suddenly transformed.

John Hewish

Forum

OUT AND ABOUT Notes of a fart

John Hillaby



When the kids at school used to boast how their dads collected a gong for ramming a U-boat or capturing God knows how many Uhlan single-handed at Ypres it saddened me more than somewhat for I knew darned well that my old man had been turned down by the Green Howards on account of his flat feet or varicose veins, I forget which, but with the exuberant imagination of adolescence, I slowly achieved renown at Dotheboys' Hall by claiming descent from Ketill Flat-Nose, Siggytrig Silky Beard and Olaf the Fart. That last one grabbed those who didn't know Fart meant the Journey Maker. And come to think of it, there could be a grain of truth in what I said since my folks came originally from the North Riding; we bear a Scandinavian name and it was from Hedeby at the root of the Jutland peninsula that Black Gottfrid launched hundreds of those long ships with their terrible prows. Moreover, when I was in shorts in the days of the Peacemaker, we spent the greater part of the summer at Scarborough, a town named after an old pirate called Skadis who sacked the place somewhere around 800 AD.

It is of Scarborough, the inspiration of my boyhood, that I intend to write here for the remaining grace of South Bay is being threatened by bureaucratic barbarians though there is a faint hope that tunny are inching back into the North Sea. My authority for the latter is a short piece in *The Yorkshire Post* which relates how Fred Walkington, the coxswain of the Bridlington life boat, recently caught an extremely small specimen in his salmon nets.

You will recall how, in the 1930s, the great game fishermen of the world flocked to Scarborough, intent on hauling out those giant relatives of the mackerel that follow the herring shoals. Though an ardent fisherman myself I never caught one. I had neither the money nor the opportunity, but one night as I fished off the sea wall with a rod made from a Long Tom billiard cue, a distinguished looking character hove up and asked how the billet, the local name for coal fish or saithe, were running. I said fine and showed him a brace or two. Had he been fishing himself? Colonel Peel nodded and said he had caught three the previous day with a total weight, as I recall, of something over 2000lb. "Perhaps you'll hook some of the big chaps yourself one day," he said.

In fact, I did but it cured me of serious fishing for all time. Nile perch fight like lassoed cows and bleed fearfully when you gaff them ashore. Without sounding over-pretentious I can't say precisely how my passion died except that, after mastering a sport, it's more rewarding to find out how animals live than profiting, sensually, in the manner of their death and, anyhow, by the time I returned to Scarborough, the tunny had disappeared probably because the great shoals of herrings, "the silver darlings", had all but been cleaned out.

As I strolled down the Marine Drive the other day, musing on these nostalgic matters, I heard of yet another threat to the northern queen of watering places. Some paper-brained time-servers from the regional planning office want to carve up the Spa. Now this may be fairly compared to chopping the Albert Hall in half.

The Spore, as the day trippers call that elegant building, glittered in the late Victorian and Edwardian era when Lord Lonsborough had a house in The Crescent and took his guests down to the hall by the sea on many a merry night. Old Meyer Lutz handled the music. In 1871 the guests included the Prince of Wales and Princess Alexandra. There may still be a painting in the town hall that commemorates the scene. HRH looks slightly cut as he leans nonchalantly against a lamp post, sur-

rounded by the quality in top hats and frock coats though at least half of them, it seems, weren't really there at all. The artist is reputed to have collected some handsome backhanders by painting them in right royal company.

Scarborough has suffered a mord of gross architectural setbacks. Despite protests by that Augustan figure, Tom Laughton, brother of Charles and Frank, they quarried the famous Pavilion Hotel and, I forget when, they erected a hideous "Space Ship", some 60ft in length, at the foot of St Nicholas Gardens overlooking the South Bay. It was launched by Frances Day and some character from the British Interplanetary Society who should have known better. The handouts proclaimed that the first people to reach the Moon in Scarborough's new space ship would be the members of the Town Council and there were those of us who hoped they would stay there. I don't know whether you can blame any of this on the lingering genes of Skadis, the Fart and company. The Norse were a wild lot but they didn't screw up places on which their livelihood depended. □

PIG-IGNORANT

About first thoughts

Peter Laurie



The porcine eye, skimming idly over the 28 July issue of this excellent paper, was stopped by a casual question posed by Dr Paul Davies on p 239: "Where did all the information come from?" By that cryptic teaser, he meant all the information in the universe which is even now vanishing as entropy increases. Now, to the ignorant mind, this increasing entropy stuff looks like one of those terrific generalisations which afterwards turns out to be

quite misleading because some Nobel Prizewinning chum in the 1920s dropped a decimal point and no one's been saucy enough to check since. (Like the redshift, which seems to be discredited every six months.) But that aside, where did all the information come from?

Myself: (after a long pause) "That is a very interesting question." *The Plain Men of Science:* "We are well aware of that. The answer, however, would be even more interesting."

Myself: (wheedling) "A person who answered such a question, might he not expect to receive some sort of honorarium, grant, prize, or tax credit in Eurodollars?"

The Plain Men of Science: "No commitments can be made prior to scrutiny of candidates' scripts. Please write in triplicate, on one side of the paper only."

Myself: "I will be frank with you. When I first got up, this seemed a good idea. It is more difficult now to get into than I thought."

The Plain Men of Science: "No one compelled you to write about this thing. Please be brief. Our time and attention are limited."

Myself: "Stagefright. We writers of the more sensitive class are martyrs to it."

The Plain Men of Science: "Get on with you."

Myself: "Oh, all right, all right."

I don't know where all the information came from. But the question raises another one about the minds that perceive the information, and I was reminded of an aside of Koestler's in *The Case of the Midwife Toad* about how the brain might be what it is—an enormously complicated, sensitive amplifier—because the mechanisms of intelligence, consciousness, and perhaps telepathy and ESP generally, take place at a subatomic level, and the brain serves to amplify them to a size where they can have physical effect. Because if you don't accept that the universe is just matter, then it is hard to see how else the parallel universe of soul can have an effect except through us—and I suppose, to

* With grateful acknowledgement to Flann O'Brien.

a lesser extent, through animals' brains. Because matter in larger lumps than the atomic obeys such strict statistical laws that there seems no room for manoeuvre. But within the atom, where all is uncertain, there is still a place for free will and moral battles of the most interesting sort.

Of course, this interpretation lays one open to the charge of a anthropocentrism: why should one imagine that the whole universe was contrived just so that some parasitic scum of an insignificant planet of an obscure . . . etc? But that objection implicitly refers to the view of a big whiskered referee in the sky. If you have brute matter, with no will, and brute soul with no action, and the only place they can meet is in brains of at least the complexity of ours, then by definition there is no referee in the sky. Where the two sides meet—in your head, in mine—is the only place where meaning can exist. It is entirely up to us to decide what it is all about: the decisions we make, here, now, before breakfast even, are it, the reason and justification for the whole of creation.

Myself: "Very well then: sausage, bacon, tomato and two eggs please." (Try to think of all this in terms of zen, and it might make more sense.) So although information in the material universe may be running down, I would have thought it might be going the other way in the little hot zones of consciousness which people nurture and surround. (My eldest son just tells me that everyone knows where all the information came from: the big bang. Maybe he is right.)

PERSPECTIVE

The NSU mystery

Brian Inglis

General practitioners used to call it "honeymoonitis" when they were feeling frivolous; "non-gonococcal urethritis" (or vaginitis, according to the sex), for their records. Then it became "non-specific urethritis/vaginitis". And when I was link-man on a programme which Granada TV put out about VD 20 years ago, a point at issue was whether it should be included. Of course it should, one of the tame venereologists insisted; because it is venereally—sexually—transmitted.

He was not saying that it could only be acquired through sexual intercourse; but he was implying that it was so rarely acquired any other way that it was safe for a doctor to assume, if there had been intercourse, that it was the source. There was consequently no reason for regarding NSU as a goodie, compared to the baddies gonorrhoea and syphilis. And this view has tended to gain adherence in spite of the uncomfortable fact that specific pathogens where they have been found, are often found in one partner, not in the other.

Now the diagnosis "venereal" has been challenged in *World Medicine* by Neville Rosedale, consultant venereologist at the West Middlesex. He does not dispute that trichomonal urethritis in the male, when it is diagnosed, is acquired sexually. But trichomonal vaginitis, he insists, is most often not sexually transmitted. True, it often appears after intercourse; and the assumption has been that the man is responsible, even if no *Trichomonas* is found. "We are always being told that this is because 'Trichomonas' is difficult to find in the male". Dr Rosedale observes; "I have another theory. Perhaps it was not there in the first place". He has accordingly treated the symptoms as if they were a female condition only, without the male partner being involved; and the cure rates have been "exactly comparable to those in similar clinics where trichomonal vaginitis is considered to be a venereal disease, when male partners have been examined and (usually) treated in spite of negative findings."

What, then, is the cause of this form of vaginitis? Dr Rosedale does not pursue the question; but he gives a clue when he refers to cases of young girls getting it after their first ever act of intercourse, and women in middle age getting it after starting up a new sexual relationship.

Just after the war a friend of mine, a houseman in a Dublin hospital, was put in charge of the VD clinic; and he was shocked to find that no attempt had been made before to subject patients



to tests of any kind. It had been assumed that nobody would come to such a clinic unless he had gonorrhoea or syphilis, and the appropriate treatment followed after a cursory inspection. My friend promptly instituted routine tests and found, as he had expected, that patients who thought they had gonorrhoea in fact often had NSU. But what he also found, and had not expected, was that a proportion of patients who thought they had syphilis, and who actually had the symptoms, had a negative Wassermann reaction.

He was irritated, as well as baffled, by this discovery. He had planned a research paper on the whole subject; but being of impeccable orthodoxy (clinically, at least; he is also remembered in that hospital as the man who, after a party, dropped the hospital gown down the well of the central stairs to find what kind of a noise it made on the flagstones below) he could not bring himself to accept that the chances were psychogenic. Consequently he could not present his findings until he found what pathogen caused them; and this he was unable to do. But I have since found that psychogenic, or hysterical, symptoms of both syphilis and gonorrhoea are regarded as a commonplace by doctors who accept such things—though not, of course, by doctors who assume that every physical symptom can ultimately be traced to a physical cause.

By what process are the symptoms activated? Commonsense would suggest that it must be similar to that with which schoolgirls are traditionally familiar: if they are prone to acne, it will afflict them just before the school dance. All of us know what it is to blush, for shame; as sex is so often loaded with guilt feelings, it is hardly surprising that they may be powerful enough to interfere more drastically with the body's auto-immune processes, perhaps by some mechanism comparable to that which produces allergic reactions.

Anyway: whatever the cause, if the "honeymoonitis" diagnosis was right all along, this should be recognised. Although vaginitis may not be the most important outstanding problem of modern medicine, as Dr Rosedale points out, "even now, in our permissive society, some thought should be given to the emotional and social upheaval that often follows the diagnosis of venereal disease"—even if it is cloaked under the more refined title of "sexually transmitted disease."

WESTMINSTER SCENE

Trouble with shoes

Tam Dalyell MP



Like children, MPs adore ending term with some kind of a beans or orgy of recrimination. This year was no exception, when the last day's business—Adjournment debates—was "lost" with a thundering row about Downing Street security, and peremptorily "sending for the Prime Minister"—something that gives back-benchers the greatest delight, as a confirmation on their power, which often seems to be fleeting. So it was that in all the stramash, too little attention has been paid to the important statement on the footwear industry, by Alan Williams, Minister of State at the Department of Industry.

Forum

continued

He told the House that the Steering Group's report was valuable and comprehensive. Twenty three of the 55 recommendations were directed to government, and action had already begun on some of them. Williams said that he was conscious of the need to avoid creating uneconomic capacity in Europe as a whole. However, the government was anxious to give as quickly as possible what help it could to the industry, consistent with our international obligations, including those within the European Economic Community, and in keeping with the constraints on public expenditure.

As to the recommendation for an investigation of footwear distribution, the Director General of Fair Trading intends, said the Minister, to keep developments in the industry under review, although he has decided that at present no monopoly exists. From the Opposition Front Bench, Norman Lamont, Kingston-upon-Thames, said that he noted from the report that the technology of the shoe industry was up-to-date and that industrial relations were good, and "therefore action has to come from the industry itself to improve its position in world markets, and that we agree with the Minister that this is more important than government expenditure."

John Garrett, who represents Norwich and an important sector of the shoe industry and who was one of the four members of the steering group, asked when the proposed sums of money, part of the £11 million earmarked for investment, would become available. Secondly, what had become of the planning agreement, which had the support of both Labour and Conservative parties, employers and trade unions, and was to be signed with leading companies in the footwear retail trade?

One of the reasons, said Williams, why the government wanted to have further discussions with the industry on the question of finance was, that if this was to be available, it should be advanced as quickly as was practicable. Instead of trying to provide finance under a completely new scheme, which would take time to prepare and process it would be better to identify some sources of finance which are already in existence.

Planning discussions, which were the precursors of possible planning agreements, were under way with about six companies. Betty Harvie Anderson, East Renfrew, asked the government to watch one of the main supplying units—the leather suppliers. If the government were to intervene through the National Enterprise Board, would the Minister assure the House that the intervention would not help one area in terms of employment at the expense of another which would lose jobs in consequence? Williams said that there was no shortage of leather supplies.

Greville Janner represents Leicester, and the largest shoe warehouse in the whole world. He asked for special attention to be given to areas dependent on the industry, a far cry from a decade ago when Leicester could boast probably the fullest employment in Britain. Like others, John Farr, representing Market Harborough and the Leicester commuter belt, was concerned about cheap exports from the Far East including South Korea, and also from certain Iron Curtain countries.

Williams pointed out that rubber footwear from Eastern Europe and all footwear from China were covered by quotas, and that Britain had recently negotiated voluntary restraint with Poland, Czechoslovakia and Romania on leather footwear and anti-dumping.

Willie Ross, the former Secretary of State for Scotland and MP for Kilmarnock which has recently been hit by the shutdown of Glenfield Kennedy, the engineering firm, was concerned about Italian competition. Williams replied that within the EEC there are control mechanisms to ensure fair competition. But "one has to appreciate that the Italians' supremacy on the continent in this respect has arisen substantially from their greater investment in designs." They had some very interesting experiments in design operation, also much higher capital investment. Frank Tomney, North Hammersmith, brought the House down to earth by asking "in this welter of questions, important as they are in relation to trade and industry, and imports and exports in this country," if he could ask one important question on behalf of the general public? As women get older, Tomney revealed to the House, they get broader in the bottom and broader in the feet. There is a dearth of wider fittings with style and comfort for elderly and middle aged women. This was a grievous problem for the public. "Women can go from shop to shop, hour after hour,

seeking shoes to fit them." The market was geared to young people. Williams said he would bring it to the attention of the industry, since it was a real problem. Let's see. □

WASHINGTON VIEW

OSTP survives

Dan Greenberg



There is always a bit of a controversy about the size of the President's staff, as though it really matters whether a few more or less persons serve the chief executive at the White House and the nearby executive office of the President. But since all recent presidents have promised us frugality while continuously running up deficits, the size of the staff right there on the President's own territory is a sensitive matter.

For Jimmy Carter, however, it is an especially sensitive matter. Campaigning on a pledge to reduce and reshape the US government, he said that one of his first acts would be to cut and reorganise the presidential staff. And since Mr Carter sticks to his promises, even if he has to pursue them out the window, he has now carried out that promise, though the wisdom of it is open to question.

The presidential staff, it should be understood, is no mere handful of people. Rather, it is a regimental-scale enterprise that in recent years has hovered close to the 2000 mark. By some accountings, it has gone above that figure at times, thanks to a bit of administrative hanky-panky whereby people are seconded to presidential service but remain on the payroll of outside agencies.

In any case, though it's difficult to understand the obsession over whether the boss of a \$400 000 million-a-year government spends \$80 million or \$90 million for staff services, the obsession persists. And just recently, in fulfilment of his campaign promises, Mr Carter unveiled his new staff arrangements.

Numerically, the basic element is a reduction from 1712 staff slots to 1459, which, by White House reckoning, will save \$6 million a year. The cuts will be achieved by lopping off and relocating a number of peripheral functions that were long ago placed in or near the White House for lack of a better site, and also by reducing the staffs that remain behind.

While the reorganisation study squad was making its rounds of the White House and the executive office, it was widely rumoured that the newly established Office of Science and Technology Policy (OSTP)—successor to the science office that Nixon abolished—would be dismantled and relocated. Created late in the Ford Administration, the new science office went without a director for the first few months of Mr Carter's reign, which suggested that he didn't consider it to be indispensable.

Nevertheless, OSTP has survived the reorganisation, though with its staff numbers severely pared down and several of its functions transferred elsewhere. The staff reductions amount to 10 of the 32 positions previously authorised, which is no small number for an office that is supposed to advise the President on everything from weapons technology to dam safety. But perhaps more important, OSTP has been shorn of a number of functions



that Congress diligently wrote into its charter when it resurrected White House science advice last year. (Under the rules for reorganising the government, the White House may do what it pleases, unless Congress objects within 60 days; since presidential staff is regarded as a presidential prerogative, objections are unlikely, even on matters about which Congress once indicated strong feelings.)

For example, Congressional concern about the dearth of long-range planning in the US government inspired a provision in the OSTP statute for the office to prepare annually a five-year "outlook" on problems and opportunities in science and technology. That function, along with an annual retrospective report, has been reassigned to the National Science Foundation, which has a lot of talent and resources for the task, but little influence in Washington.

Also removed from OSTP was the authority to appoint a standing group of outsiders, known as the President's Committee on Science and Technology. The committee was to conduct a two-year study of government research programmes; at the end of that period, the President could keep the committee as a continuing body or disband it. Under the reorganisation plan this group will be absorbed into an ongoing White House study of government organisation. The head of OSTP, who is also science adviser to the President, will serve as its chairman, but there's a big difference between chairing a group that's close to one's own shop and chairing one that comes under someone else's basic jurisdiction.

Various other functions have also been sliced off OSTP, among them the operation of a government-wide committee of senior R&D administrators and a panel that brought together national, state, and local research officials.

The net result of all the changes, at OSTP and in other parts of the White House organisation, is that the staff has been reduced, reshaped, and reorganised to serve Mr Carter's day-to-day needs. For the purpose of peering beyond the horizon, however, the changes do not appear to be beneficial, which is unfortunate, since foresight has never been abundant in presidential affairs. □

ECONOMICS

After Keynes

Anthony Renton



Leading figures in the Tory establishment, particularly Margaret Thatcher and Sir Keith Joseph, are now avowed monetarists. Even the Labour government—admittedly in thrall to the International Fund and hence with little freedom of manoeuvre—is now explicitly pursuing monetary targets. And in academia the retreat of so-called Keynesian demand management theories in face of the monetarist attack is even more obvious.

I have outlined the main features of the monetarist approach to the analysis of the economy before (Forum, vol 68, p 601). Broadly the monetarists assert that movements in nominal magnitudes (wages, prices and interest rates) and perhaps also in real magnitudes (output and employment) are associated with changes in the relationship between the supply of and the demand for the nominal stock of money in existence. The major instrument of policy, then, should be the money supply and not fiscal instruments.

The authorities in practice cannot control the money supply as tightly as some monetarists assume because there is slippage between the banks' reserve base (which is controllable by the authorities) and the total money supply and because often the authorities choose to alter the supply of money in response to variations in the public's demand for money. The public's deci-

sions about how much money it wants to hold in the form of cash and how much in the form of bank deposits and the banks' portfolio decisions both loosen the connection between bank reserves and the total stock of money. Secondly, in order to maximise the private sector's appetite for gilts and so finance much of its borrowing requirement, the government often pegs interest rates by creating whatever money is necessary at that interest rate structure to satisfy the demand for money.

However this is not a refutation of monetarism. Provided the public's and the banks' behaviour is systematic—and the evidence suggests it is—control of the money supply is still possible, though difficult. And if the Bank of England chooses to control the level of interest rates rather than the supply of money—and it cannot do both—such behaviour cannot be used to refute monetarism.

It is alleged by those of a crude Keynesian persuasion that variations in the money supply cannot influence the economy because there is a very high degree of substitution between money and money-substitutes (which are assumed to be in near-infinite supply) so that the public can always get the means of exchange that it wants from some source or other. This assertion is formally embodied in Keynes's "liquidity trap", where bonds play the role as the substitute for money, and the Radcliffe Report's claim that money is merely the small change of the system and that financial intermediation makes the demand for money very sensitive to variations in the rates of return on financial assets and hence that it would take huge movements in the supply of money to affect interest rates and ultimately investment, housebuilding, etc.

But, again, so long as the terms of substitution between money and all other assets are stable, this is no refutation of monetarism. What is true is that the existence of a complex and sophisticated financial system makes the use of monetary policy to control the economy, not important, but difficult.

One way in which monetarists have helped us to outgrow the Keynesian legacy is by emphasising the international nature of most economic problems. This resulted from their tendency to view commodity and capital markets as integrated units and to avoid focusing on the particular circumstances of individual countries.

This view of the world as a single system with a number of fierce competitors, each of whom has little control over how the total system develops, has been enormously fruitful. For example, world competition can be expected to establish one world price level and interest rate to which national prices and rates of interest will tend to conform. The implication is that so long as a country maintains a fixed exchange rate it cannot in the long run avoid the world rate of inflation. Also, the central bank's control over the supply of money will be weakened because the public can always adjust its nominal money holdings by importing or exporting money via a balance of payments surplus or deficit. Control over the domestic rate of inflation can be regained only by severing the link between the national and the world systems, that is, abandoning a fixed exchange rate, thus enabling the economy to act as if it is a closed economy. A corollary is that the effects of a devaluation on the payments balance will be merely transitory, but it will permanently raise domestic money prices.

It follows also that the rate of world monetary expansion relative to world output growth is very important, for this affects the world rate of inflation and hence, in the absence of floating exchange rates, the domestic rate of inflation. In practice, given exchange rates partially or fully tied to the dollar and the fact that most of the world's stock of international reserves is held in dollars, this means that the rate of world inflation is determined largely by the policy of the US Federal Reserve.

These ideas are not new but have had little impact on policy-makers until recently. This is partly because Keynes wrote the *General Theory* on the assumption of a closed economy and his followers never bothered to work out the monetary implications of balance of payments disequilibria. Secondly, the shift in the centre of gravity of economics from Europe to the USA since World War II—that is, from open, small economies to a much more self-sufficient and huge economy—meant that the profession was slow to see how unhelpful the closed economy assumption is in fact. □

Letters

Beffinger hypothesis

Sir.—I was surprised to learn (Letters, 21 July, p 187) that Robert Waller appears to discount the idea that food growing methods and food processing can have serious effects on human health including a rising incidence of malignancies. Mr Waller of all people should know about this because he was the editor of an important book on the subject (*Just Consequences*) which was published about six years ago.

Why he should now transfer a lot of his allegiance to the inconsistencies of the Beffinger hypothesis is puzzling. The Beffinger hypothesis just won't stand up to a wide global analysis as I am sure many expert witnesses among the readership could testify. Some areas would seem to benefit when they smoke exclusively air-cured tobacco; others do not, and these include the western republics of the USSR, particularly their large industrial towns and cities.

There are indeed areas in Europe where the incidence of lung cancer is as great among the smokers of pipe tobacco and cigars as it is among the cigarette smokers (in Sweden for example). Sometimes it is greater as in Switzerland and Germany. At least that is what the statistics say.

It is generally agreed that the greater risk applies to inhalers. About 92 per cent of British male cigarette smokers are inhalers. Air-cured tobacco, though it produces an alkaline smoke, contains much more tar. If smokers cannot or will not break the inhaling habit, they would most probably be subjected to a greater risk by

changing over to air-cured cigarette tobacco. Even Cuba has a high rate of lung cancer and there they smoke mainly air-cured cigars. Sigmund Freud, the neurologist and psychoanalyst, was firmly addicted to smoking cheroots and he died from cancer of the mouth in London in 1939.

We should disabuse our minds of the notion that lung cancer has one causative agent or even one main causative agent. Likewise, there is no one lifeline to safety as Mr Waller and others would have us believe. The disease probably arises out of a series of interactions which operate within the complex multifactorial situation of a modern industrial state.

To appreciate this we have to look a little wider and farther than the naive compilations of smoking and malignancy statistics with all the unwarranted assumptions that usually accompany them.

Simple societies don't get lung cancer, coronary thrombosis, diabetes or neuroses for the "simple" reason that they have no chemical and heavy metal pollution, no advanced technology, no inorganic medical drugs, and most important of all, they have no slab-making disease-promoting supermarket convenience foods.

The statistics quoted—or implied—are taken from the Royal College of Physician's reports, the WHO reports and Professor Bernard Benjamin's recent analysis of the WHO figures.

Frank Rogers

5 Woodlea Avenue
Upton Heath
Chester CH2 1ND

Belief in God

Sir.—I would like to express my disagreement with views expressed in Professor Josephson's letter (Letters, 23 June, p 733) in which he referred to the article "Scientists who believe in God" (26 May, p 478).

He questions whether there is any *a priori* reason why science cannot encompass in its laws spiritual truths as well as laws relating to the behaviour of matter and energy. I would like to suggest that there certainly are valid reasons why this cannot be done. The spirit that is in man enables him to know and understand the things of man and of the natural world in which God has placed him. In a similar way it is the Spirit of God that reveals the things of God. Consequently natural man (that is, man unregenerated by God's Holy Spirit) is unable by any means whatsoever to receive the things of God, and so cannot appreciate spiritual truths which appear foolish to him because they are spiritually discerned. Thus any attempts to encompass spiritual truths in the framework of scientific laws will be completely abortive.

Professor Josephson expresses a "progressive" attitude to spiritual experiences, that they have causes that are of a physical nature. Spiritual experience rather has its cause in God's love for helpless fallen human beings. This spiritual experience consists of a personal relationship with a living personal God and is thus completely beyond the limits of explanation of physical theory. It is not a comparative few

who are able, by virtue of a special sensitivity to have spiritual experiences, as Professor Josephson suggests. It is man's sin and not his lack of sensitivity which prevents him from entering spiritual life and experience. However, God has graciously made a way of reconciliation open to all men, through the sacrifice of His Son.

Professor Josephson states that the fact that the properties attributed to God are rather different from those of ordinary material objects, is of little relevance to a man in distinguishing between different colours whether or not he is blind! I do not see how science is able to include any of the attributes of God (holiness, love, wisdom, omnipotence, omniscience, eternity, self-existence, immutability and transcendence) into its framework.

Professor Josephson also asserts that since modern physics can now deal with qualities far removed from common experience a theory of God need pose, at least to a first approximation, no serious problems to the modern physicist. Yet God's thoughts are not our thoughts, nor are His ways our ways; for as the heavens are higher than the earth, so are His ways higher than our ways and His thoughts far above our thoughts. God is not so tiny that He will fit neatly into our scientific theories for He is the Sovereign Lord, Creator and Sustainer of the universe in which He has placed us. The vastness of this universe may appear to make man insignificant, as Professor

Grimbledon Down



Josephson points out, but not in God's sight, for He desires to know personally every one of us and consequently we can live lives which we know have meaning, purpose and significance.

Religion and science will never be united by an extension of the scope of scientific enquiry which is by its nature limited to investigation of the creation of God and not God Himself. However the knowledge of our world and our universe, which not only scientific enquiry but our eyes and everyday experiences affords us, should lead us to seek to know and worship this Creator.

H. J. Strangeways

Department of Physics
The University
Southampton

Phenomenon

Sir.—The persistence of long, narrow, straight or winding lanes of smooth water at sea or on rivers is a phenomenon that I, like Cedric Smith (Letters, 21 July, p 185), have often noted. As Smith says, the patterns are quite different on different days and the lanes are a few metres wide and several kilometres in length.

I imagine they are due to the presence of localised thin films of surface pollution, for example, oil, whose calming effect on troubled waters is well known, since the passage of a ship usually creates a new lane that slowly drifts and twists during several hours under the influence of the winds and tides.

During a recent trip on the QE2, I found that they hardly occur at all in mid-Atlantic, but are, sadly, very common in coastal waters on both sides of the Atlantic.

Robert H. Crabtree
Sterling Chemistry Laboratory
Yale University
225 Prospect Street
New Haven
Connecticut 06520
USA

A poisonous corkscrew?

Sir.—The article "Corkscrew for London's bottlenecks" (21 July, p 147) praises the GLC's computerised traffic control system for making it so easy to cross rather than bypass London that even heavy lorry traffic increased until banned from the centre. At the same time the author, Mr Aldous, is

clearly pleased by the "advantage" of the system in supposedly doing away with the need for a good ring road around London.

It is ironical that the author is described as an "environmental" journalist. In the very same issue "Air pollution underestimate in London" (This week, p 141), your own health and safety correspondent, Lawrence McGinty, highlights the problem of smoke pollution in central London, caused by the very vehicles that can so easily cross London now instead of being routed round it. Since to quote Mr McGinty, hundreds of thousands of people spend considerable part of their day in this zone, it would appear that temporary upsets caused by road construction would be preferable to the steady increase in pollution of the centre, the inevitable result of giving in to the so-called "environmental" anti-road pressure groups.

It is debatable whether, as Mr Aldous claims, the urban motorway plan lost the Conservatives a GLC election; but it is an undeniable fact that the Conservatives *won* the recent GLC election partly because of the inept traffic policies of their predecessors. And indeed, the new GLC transport plan again includes some new road construction.

Ian S. Menzies
Asphalt and Coated Macadam Association
25 Lower Belgrave Street
London SW1W 0LS

Like it is

Sir.—Truman Capote's suggestion (Ariadne, 7 July, p 64), to demonstrate the "arbitrary and absurd" nature of the grisly ritual of capital punishment, might well be applied with advantage in a slightly different context; Ariadne's proposal to switch off if confronted with a televised visit to an abattoir (21 July, p 208) exemplifies the denial of responsibility of the meat-eating public, the majority of whom regard flesh as the sanitised product of a supermarket display cabinet.

W. R. Good

The Open University
Oxford Research Unit
Fozcombe Hall
Berkeley Road
Boars Hill
Oxford

Ariadne writes:

Puzzle No. 13

A diversity of scores.

4 football teams, A, B, C and D are all to play each other once. After some, or perhaps all, the matches had been played, I discovered that 18 goals had been scored altogether and that B had scored 2 more than each of the other three. B also had three times as many goals scored against them as D had, and A had the same number of goals against them as for them. C had fewer goals scored against them than anyone else.

It was interesting to notice that in every match both sides scored at least 1 goal, and that in no matches were the scores exactly the same. One match was drawn.

Find the score in all the matches that were played.

Eric Emmet

Solution to Puzzle No. 12

The puzzle of life.

A is 36
B is 8

Touch! And daily colour film from the Vietnam killing grounds had an effect on American TV watchers that may still be detected in foreign policy.

Anti-abortionists

Sir.—Without necessarily agreeing with the precise proportion it is encouraging to read that Donald Gould (Forum, 21 July, p 181) has at last realised that "half of mankind are harsh and merciless and cruel by nature, and that they always have been and always will be, and that no change for the better has happened over the centuries, and that none may be looked for".

A theologian would no doubt revise Donald Gould's wording slightly, but the basic theme—that there are human beings who live and die in friendship with God (the source of all love, truth, beauty, freedom and order) and then spend eternity with Him in Heaven, while there are other human beings who enjoy making their fellow humans suffer and hating them and who therefore spend eternity without God—would be accepted by all conservative Christians, whether Catholic or Protestant.

I think that it is a necessary part of maturation to hope that this is not so, and that if we only say enough rosaries/go on enough Orange Marches/protest enough about conditions in South Africa and the Soviet Union, then kindness and gentleness will win over the "harsh, merciless and cruel". But somewhere along the way we realise that this is not so.

Donald Gould's wild flailing at "militant anti-abortionists who are inspired not so much by their expressed concern for the unborn child as by a gut feeling that any woman who enjoys sex for its own sake should pay the full price of her indulgence in the travail of childbirth and the burden of reluctant motherhood", shows a close emotional relation to many other almost-converts, who are still speaking their old beliefs while gradually knowing better in their hearts.

Having been a militant anti-abortionist for 10 years, including being chairman of Edinburgh SPUC for two years I can think of only one person who *might* have been so motivated, though I do not think so. The rest, and this can only be a subjective estimate, enjoyed sex and motherhood far more than the pro-abortionist ranks.

Dave Parry

19 Carbarns West
Netherthorn
Wishaw
Lanarkshire ML2 0DE

Windscale

Sir.—A number of important points arise out of your correspondent's report of our work at the Windscale Inquiry concerning BNFL's computer study (This week, 28 July, p 214).

The "assumptions" that we questioned at base were primarily concerned with the size of the release in the worst case that ought to be considered. We differed greatly from Mr Donoghue on what releases we wished to be considered.

Letters

continued

We referred entirely to work from within the nuclear industry—to Oak Ridge and Karlsruhe safety assessments, where *worst possible* releases of hundreds of millions of curies were considered.

Mr Donoghue preferred to stay in the realm of "maximum credible accident", and further to that which was credible to him, and he stopped at tens of thousands of curies. His reason was that he was able to conceive of all technical systems failing, and the tanks coming to the boil, he could not conceive of human failing them intervening such that the tanks could not be prevented from boiling to dryness—which would take a matter of some hours. The German and US studies did consider this, hence the difference in releases.

I therefore did not say that the program "does not simulate a maximum credible accident", clearly it does that for Mr Donoghue. What I said was the computer, as used by BNFL, did not simulate the *worst possible* case. I did say, that whether or not the program

could simulate the worst case is something we would wish to analyse. If we were assured on that point then we would be happy to see SRD feed in the Germans or US inputs.

We did not wish to imply that the program is a "crude one"—it is the most accurate and sophisticated available and a credit to SRD. What we did point out was that the whole exercise was necessarily crude, in view of the gaps in knowledge, particularly of isotopes other than Caesium when lodged in soil, ingested, or inhaled. The atmospheric models do not pretend at accuracy, in view of the other uncertainties. All these limitations are pointed out by SRD in the manual and were one of the reasons given by us in request of the program for independent study.

It should be clear from the above that the program does not consider 'starting mechanisms' for a release, such as aircraft impact or sabotage. Any criticisms we might have if the structure of the program itself would of course be open to criticism themselves in the appropriate literature. Our consultations with SRD are aimed at helping us run the program ourselves, and they wish, of course, to be in no way associated with any results we might present. In addition, we, in cooperation with other objectors, would wish SRD to run the program with German or US inputs, but this is subject to sanction by BNFL and must be mutually agreed. These results might well be presented at the Inquiry, but our work on the structure of the program itself will take longer—PERG has no full-time paid employees!

Peter Taylor

Political Ecology Research Group
c/o Civic Hall
Windlesham Inquiry
Whitehaven
Cumbria

Postal system

Sir.—I was interested to read both Mr F. Quelon's letter (Letters, 12 May, p 356) and Mr C. Leighton's letter (Letters, 2 June, p 550) and wondered if both gentlemen realised exactly what their proposals would involve.

A binary code of up to 30 digits is out of the question as the Post Office cannot afford to install machinery to handle its present codes of 6-7 digits

which, as is widely known, are redundant at the moment; I believe, only the Head PO in Aberdeen and Manchester can handle pre-coded letters. Even this can only be done with letters sent to and from these two cities.

Standard size envelopes are also a pipedream as anyone in business will tell you that even a small office will despatch as many as four different sizes of envelope every day.

Just what "existing and well tried techniques" does Mr Quelon refer to? Could it be the small red vans that barely manage to trundle from post-box to PO?

How much do we think this "posting machine" would cost the people of this country, who would only be able to post one size and thickness of letter, have to be able to type, have their correct money ready and press buttons.

How many PO unemployed could Britain afford to sustain in the dole queues with Mr Leighton's "modern technology"?

I would have thought that this impractical, uneconomic and I feel, unusual wish for a standard letter should be looked at more realistically. After all ours was the first and is now the best.

K. McDonald
4 McNeill Terrace
Loanhead
Midlothian, Scotland

However, I agree with Dr Tampion that the course does not go in enough detail into any of the sciences and is, therefore, not good enough for those who will continue with the study of science at a more advanced level.

Thus I agree that those who are likely to continue with the study of science should be selected at an early stage and offered more conventional science courses.

Leon M. Rosewicz
13 Sunningdale Close
Stanmore, Middlesex

Solar photon sail

Sir.—Having read several articles recently, in *New Scientist* and elsewhere, about the proposed NASA solar photon sail for propulsion of long-distance spacecraft, I have yet to see any discussion of the means by which such a craft could progress on any point of sailing other than a direct run, i.e. directly downwind, to the terrestrial nautical analogy.

Sailing close-hauled (into wind) or even on a reach, requires a lateral reaction from the surrounding medium; in popular parlance, the keel of a sailing boat "gives a grip" on the water. This force, largely normal to the direction of motion, resolved with the aerodynamic forces on the sail (set at the appropriate angle) produces a resultant in the direction of movement. Where the lateral area is too small the craft makes excessive leeway, and in the end would be blown straight downwind (imagine an inflatable dingy, or better still a hovercraft with no other motive power, trying to sail at an angle to the wind).

At first sight, therefore, unless I've missed some subtlety of the mechanics involved, a spacecraft in a virtual vacuum can get no reaction force from its surrounding medium; the only other forces which might be invoked would seem to be gravitational fields of bodies other than the Sun itself (for that would be in exactly the wrong direction). As an amateur sailor, I'd be delighted to learn of some new principle that would make that drag-provoking keel unnecessary!

Donald Reeves
Field Cottage, Crondall
Farnham, Surrey

ELECTRONIC CALCULATORS

SCIENTIFIC

SPECIAL OFFER TEXAS SR52 together with PC100A £324-00

*TEXAS TI59 (New Card prog 960 prog steps or 100 mem) £205-00
*TEXAS TI58 (New Key prog 480 steps or 100 mem) £274-00

*TEXAS PC100A (Printing Unit for SR52/SR56/TI58/TI59) £161-23

*TEXAS SR56 (10 Mem/100 mem) £180-00

*TEXAS SR54 (10 memory; key programme 100 steps) £54-00

*TEXAS SR51 II (3 Mem/Stat/PC) £41-00

*NOVUS 54251 (100step programme) £123-80

*CRM 4140R (Scient-Exp 10 dig) £20-75

*CRM 4140R (Scient-Prf-Prog) £28-15

*CRM 4140R (Scient-Prf) £28-00

*Nav (NAO) & Stat (541) prices on applic.

*HP 10 (Hand Printer) £110-00

*HP 25 (Programme) £79-00

*HP 26 (Programme) £79-00

*HP 47 (Fully prog.) £289-00

*HP 92 (Scientific Printer) £425-00

*HP 97 (Fully prog. with Printer) £507-00

*CASIO FX-1000P (Sci, 11 mem, 10 digit) £115-00

*CASIO FX-100P (as above but card prog) £115-00

Mains/charger included.

Other calculators available include:—

Adler, Silver Reed, Olympia

SPECIFIC ORDERS PLEASE REQUEST

GOODS FULLY GUARANTEED

PRICES EXCLUDE VAT (ADD 8%)

BUT INC P.P. CHEQUE WITH ORDER

Company/hospital and Government orders

EXPORT ORDERS ACCEPTED

Bankers card/Access accepted by phone

Tel.: 01-455 9855

MOUNTAINDENE

LTD

22 Cowper St. London EC2

newScientist

Classified advertisements

LINE RATE £1.30 per line CM RATE £6.30 per single column cm.

Advertisements received by noon Monday will normally be published the following Thursday.

A charge of 50p is made for the use of Box Numbers

Please send your advertisement to
Classified Advertisement Department,
NEW SCIENTIST,
King's Reach Tower, Stamford Street,
London SE1 9LS.
Telegrams: Verditrus SEI!
Telex: 915748 MAGDIV LDN
Eric Nithsdale Group Recruitment Manager
tel 01-261 5731
Advertisement Executive
End Broderick tel 01-261 5617
Advertisement production:
Tim Hartney tel 01-261 5951

APPOINTMENTS AND SITUATIONS VACANT

INFORMATION OFFICER

£5009-£5780 pa

International Aeradio is one of the world leaders in aviation and communications services and is engaged on a number of major contracts worldwide, comprising electrical distribution systems and equipment including airport lighting and terminal building facilities. We are currently recruiting for a Science Graduate who has experience and/or a post-graduate qualification in Electronics, in order to fill this new position. The successful candidate will be responsible for the provision of an efficient and effective Library & Information Service to the staff of IAL and will report to Head of International Affairs.

It is envisaged that suitable candidates will be between 35-55 years, meticulous about routine matters, have the ability to plan, monitor and adapt new services to changing user demand, to communicate at all levels, and to motivate and encourage others. Initially, the successful applicant will be working independently, soon setting up the service but will later have supporting staff.

We can offer a salary in the range of £5009-£5780 per annum (inclusive of London Weighting) with excellent fringe benefits.

Applications should be by hand-writing, quoting Ref: 315 to: J. Smith, Recruitment Services Officer, International Aeradio Limited, Aeradio House, Hayes Road, Southall, Middx.

THE ROYAL MARSDEN HOSPITAL

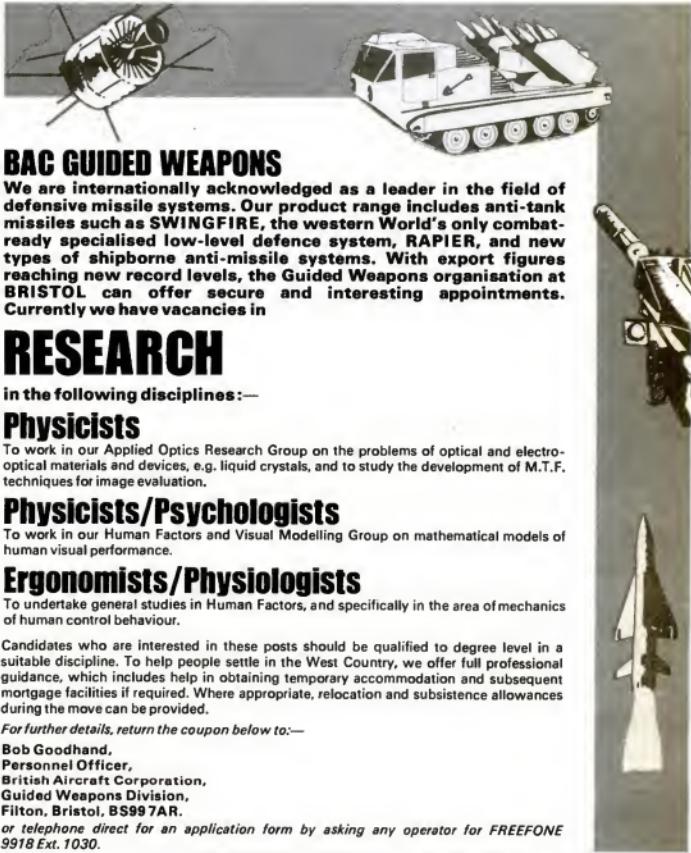
Fulham Road, London SW3
MEDICAL PHYSICS
TECHNICIAN (GRADE 4)
£3163-£4130

with an interest in radiotherapy treatment techniques required in the Physics Department to work with a team of physicists and engineers. The successful applicant will be responsible for instrument and machine calibration and testing, and will assist with routine maintenance of equipment.

Applicants should hold HNC, HND or a degree in physics or electronics. Appropriate training will be given.

Application Forms and Job Description from Miss J. Boyce, Personnel Department, Tel: 01-562 8171 Ext. 446.

Closing date—26 August, 1977. Salary quoted is inclusive of all allowances.



BAC GUIDED WEAPONS

We are internationally acknowledged as a leader in the field of defensive missile systems. Our product range includes anti-tank missiles such as SWINGFIRE, the western World's only combat-ready specialised low-level defence system, RAPIER, and new types of shipborne anti-missile systems. With export figures reaching new record levels, the Guided Weapons organisation at BRISTOL can offer secure and interesting appointments. Currently we have vacancies in

RESEARCH

in the following disciplines:—

Physicists

To work in our Applied Optics Research Group on the problems of optical and electro-optical materials and devices, e.g. liquid crystals, and to study the development of M.T.F. techniques for image evaluation.

Physicists/Psychologists

To work in our Human Factors and Visual Modelling Group on mathematical models of human visual performance.

Ergonomists/Physiologists

To undertake general studies in Human Factors, and specifically in the area of mechanics of human control behaviour.

Candidates who are interested in these posts should be qualified to degree level in a suitable discipline. To help people settle in the West Country, we offer full professional guidance, which includes help in obtaining temporary accommodation and subsequent mortgage facilities if required. Where appropriate, relocation and subsistence allowances during the move can be provided.

For further details, return the coupon below to:—

Bob Goodhand,
Personnel Officer,
British Aircraft Corporation,
Guided Weapons Division,
Filton, Bristol, BS99 7AR.
or telephone direct for an application form by asking any operator for FREEFONE 9918 Ext. 1030.

I am interested in a career with Guided Weapons.

Name _____

Address _____

Ref. 22/CRG/GW

*British Aircraft Corporation . . .
a BRITISH AEROSPACE company*

Real Involvement in R&D

De La Rue are the world's leaders in security printing and money systems with a turnover exceeding £90million. Our business is an intriguing combination of rare traditional craftsmanship and the latest scientific research. To this end, the high quality team researching printing techniques and associated materials at our Research Centre is being expanded to meet increasing demands, as follows:

Materials Scientist

To assist the Senior Scientist in developing new materials and techniques in Security Printing. The scientist we seek should have a degree in chemistry or materials science coupled with an at least five years' industrial experience associated with electro forming and plastic coating technology. Salary according to experience but likely to be around £4000.

Research Scientists

To carry our laboratory work, an important supporting role, and to train as future experts, we need young Chemists, qualified degree or HND, who are really interested in pursuing careers in this field. Starting salary according to experience from £3000

Printing Scientist

To assist in the investigation and development of new materials and processes in the field of printing ink technology. Candidates should have a degree/HND in printing science and relevant experience would be an advantage. Starting salary from £3000.

These are the monthly staff appointments. Benefits include free life assurance and BUPA membership, a contributory pension, 4 weeks' holiday and career opportunities. The Research Centre is on a beautiful Thames-side site skirting Maidenhead, with good social, sports and amenities facilities.

If you are interested and would like to discuss these opportunities with us, please write to:

The Personnel Manager, The De La Rue Company Limited, 84/86 Regent Street, London W1A 1DL, with brief details of your career to date or telephone 01-734 8020 for an application form.

De La Rue Research Centre



Duckhams Oil CHEMIST

We at Duckhams, part of the BP Group are looking for a Technical Officer in our Research Laboratories at Hammersmith W.6.

The successful applicant will be engaged in research directed towards the development of new and improved materials within the lubricants and allied fields.

He or she should have an Honours degree in Chemistry with experience in chemical products and preferably in oil or paint technology.

We offer a progressive salary with good conditions of service including a staff restaurant, a non-contributory Pension Scheme and membership of an active social club.

Please apply stating age, qualifications, experience and current salary, to:-

Mrs. C. Miller, Personnel Officer
Alexander Duckham & Co. Ltd.
Summit House, Glebe Way
West Wickham, Kent, BR4 0SJ



MEDICAL RESEARCH COUNCIL
Institute of Hearing Research

EPIDEMIOLOGIST/ STATISTICIAN

Applications are invited for an appointment to the scientific staff of the Institute of Hearing Research. The headquarters are in the Medical School, University of Nottingham, but applicants need not be located in one of the Institute's hospital outstations and some regular travel will also be involved. Applications from a firm background in statistical theory and some experience of its application in medicine. Experience of computerized record systems would be an advantage. The post will involve collaborating with clinicians investigating the relationship and management of hearing impairment and deafness, and collaborating with psychologists and audiologists in research on the causes, course, progression, configurations and severities of impairment. In addition, advice will be required by the medical staff on the use of mathematical and statistical models and on statistical tests.

The appointment will be on the Grade I or II of the medical scientific staff (£3761-£5291 or £5423-£6665) according to qualifications, age and experience. If aged under 27, the maximum age of 30 years older recruits could be appointed for 5 years in the first instance with the possibility of tenure thereafter, except in exceptional circumstances a more senior scientific appointment of unlimited duration may be offered. Further details of the post and application form are available from Dr. M. J. Haggard, DBI, Medical School, University of Nottingham, to whom applications should be sent by 15 September 1977.

NATIONAL INSTITUTE FOR RESEARCH DAIRYING

(University of Reading)

Applications are invited for a
**POST DOCTORAL
APPOINTMENT**

in the Physiology Department, financed by a grant from The Cancer Research Campaign, to work on receptors for prolactin and related hormones in the mammary glands of female rats at different stages of development, and their relationship to oestrogen-induced mammary tumour formation.

A good honours degree in Biochemistry, Physiology or Zoology and a PhD or equivalent post-graduate qualification required. Experience in endocrinology or cancer research would be an advantage.

Appointment, which is for one year in the first instance, with the possibility of annual renewal, will be as a Scientific Officer (£2149-£2527) or a Research Scientist Officer (£2544-£4454) according to age, qualifications and experience. At least five years' relevant post-graduate experience is required for HSO. In addition, supplements of (1) £313-20 p.a. and (2) 5% of total earnings subject to a maximum of £208-80 p.a. will be payable.

Application forms are obtainable from the Secretary, NIRD, Shinfield, Reading RG2 9AT. Quote reference 77/28.

UNIVERSITY OF GLASGOW

Department of Pathology
 Western Infirmary

RESEARCH ASSISTANTSHIP

This is a three year post funded by the Scottish Hospital Endowments Research Trust to study the mechanisms of regulation of the human complement system. The applicant should possess a good honours degree in biological sciences. Salary within Range 1B, from £2909 rising to £3353 per annum plus USS benefits.

Applications with a curriculum vitae and the names of two referees should be sent to Dr K. Whaley, Department of Pathology, Western Infirmary, Glasgow G1 6NT not later than 1 September, 1977.

In reply please quote Ref. No. 3988N.

Technician Sterile Production

Armour Pharmaceutical Company Limited have a vacancy within their expanding plant at Hampden Park for a **TECHNICIAN** to work in the Sterile Production Department.

The post will involve the manufacture and production of bulk sterile fluids. Experience of this type of work is not necessary, as comprehensive training will be provided.

Candidates, male/female, should hold either HNC/HND in chemistry or a biological science, M.I. Biology or equivalent.

The company offers an attractive salary, four weeks holiday per annum, subsidised canteen and social club. A contributory pension and free life assurance scheme is in operation.

Please write or telephone for application form to: Mr. H.J.M. Mackenzie, Personnel Manager, Armour Pharmaceutical Company Ltd., Hampden Park, Eastbourne, Sussex BN22 9AG. Tel: Eastbourne 21422.



Armour Pharmaceutical Company

DIRECTORATE OF RESOURCE PLANNING Headquarters (Worthing)

Assistant Engineer

Career Grade 3-6 £2850 - £4479

Preference will be given to an engineering graduate with some experience of the Water Industry. A new graduate would normally be appointed at Grade 4.

The Directorate's multi-disciplinary teams will be undertaking many aspects of the planning and promotion of water resource developments in their area, particularly with their surveys and programmes required under Section 24 of the 1973 Water Act.

The work includes river basin resource studies, engineering and groundwater investigations, mathematical modelling and data generation. Several interesting pilot schemes such as artificial recharge experiments, low flow augmentation by groundwater abstraction, are in progress.

Computer facilities will be available, and some programming experience would be an advantage.

Benefits in certain cases include assistance with removal expenses, legal and surveyors fees for house purchase, disturbance and lodging allowance.

Application forms and job descriptions are available from the Personnel Officer, Southern Water Authority, Guildbourne House, Worthing, Sussex, BN11 1LD. Tel: 0903-205250.

Closing date for completed applications—26 August, 1977.

Southern Water



Scientists for Pharmaceutical Research

Smith Kline & French Laboratories Limited is the wholly owned U.K. subsidiary of the International Smith Kline Corporation whose interests include research and manufacture of pharmaceuticals. Four vacancies have recently occurred in the Research Institute for the following men or women:

Medicinal Chemist

This is a post-doctoral vacancy which presents an opportunity for collaboration with Biochemists and Pharmacologists in the study of the effects of novel compounds related to specific hormone action. The successful candidate will be required to synthesise novel structures and will be expected to collaborate in studies relating the structures of molecules to their biological properties.

We invite applications from candidates with up to two years' post-doctoral experience who have demonstrated a flair for organic synthesis. Preference will be given to those candidates who have experience in using physical-organic principles and techniques in their research work.

Synthetic Organic Chemist

A chemist with a good background of synthetic organic chemistry is required to join a team of Medicinal Chemists in the synthesis of compounds of potential biological interest. Prospective candidates should be qualified in chemistry to first degree level (MRIC, GRIC, B.Sc) or HND/HNC. Preferred candidates will have had at least two years' relevant industrial experience.

Physiologist/Biochemist

This is an opportunity for a Biological Sciences Graduate to join a Research Team investigating the role of histamine in the female reproductive system. The job involves examining aspects of the biochemistry of histamine in the uterus. The successful candidate will have studied physiology and biochemistry to some depth.

CNS Pharmacologist

This vacancy is for a Graduate to join a team studying the physiological role of histamine in the CNS. The post will involve the use of a variety of neuropharmacological techniques. An interest in electro-physiology and electronics is desirable.

We offer competitive salaries on progressive incremental scales, and operate flexible working hours. Other benefits include free Life Assurance amounting to three-times annual salary, and excellent contributory pension scheme and a discretionary Christmas bonus. We also give generous relocation grants to all appropriate candidates.

To apply: Write or phone for an application form to:

Richard D Nelson Personnel Officer

Smith Kline & French Laboratories Limited

Mundells Welwyn Garden City, Hertfordshire

Telephone Welwyn Garden 25111 extension 26.

SK&F
a SmithKline company

The Water Research Centre, with its two main laboratories, one at Medmenham, Bucks, and the other at Stevenage, Herts, is the national centre for water research in the United Kingdom. With a total staff of over 500 it is one of the largest water research organisations in the world. It is financed principally by the Regional Water Authorities as Members and is grant-aided by the Department of the Environment.



Surface Water Hydrologist

An honours graduate scientist or engineer with post-graduate training in hydrology is required to join a team developing flow forecasting procedures, particularly to assist the management of urban drainage systems. The successful candidate would also work in close co-operation with water authorities on the analysis of on-line data derived from weather radars and rainfall forecasts. Opportunities will be given to assist in other applied hydrology projects, within the Centre's Resources Division.

Applicants should have practical or research experience with models of catchment rainfall-runoff response, for natural catchments and urban drainage situations.

Salary depending on age and experience in the grades £2278 - £3739 plus supplements up to £516 and £3449 - £4721 plus supplements up to £522 equivalent to SO/HSO in the Civil Service but with National Water Council Contributory Pension Scheme.

Write or telephone for an application form, quoting post no. 165 to:-

Closing date for application forms
18th September.

WATER RESEARCH COUNCIL,
Medmenham Laboratory,
Henley Road, Medmenham, P.O. Box 16,
Marlow,
Bucke, SL7 2HD.
Tel: 049-166 (Hambleden) 531.

UNIVERSITY OF OXFORD GRADUATE PHYSICIST/ ENGINEER

required to join a multi-disciplinary team, within a Research Bureau, to investigate the possibility of using electrical impedance measurements to estimate the blood flow to the brain. The study will involve fundamental work on practical and theoretical aspects of impedance measurement, and computer modelling will also be considered.

Applicants should have at least two years experience since graduation, and must have been born in medical engineering.

The post is supported for a two year period, and salary will be on the Research Fellow Scale 2 (L4050-£3933 plus £312 plus 5%), with initial placement according to age, qualifications and experience.

Applicants should send their curriculum vitae, stating present salary and names of two referees, to Dr K. A. Costelloe, University Department of Paediatrics, John Radcliffe Hospital, Oxford OX3 9DU.

INFORMATION ASSISTANT

required for literature searching, abstracting and other work in a small library which deals with a wide variety of subjects.

Applicants should be under 30 years of age and have a degree in Chemistry or a good knowledge of the subject. Experience of information work is not essential. Applications, which should include curriculum vitae and where appropriate previous experience, should be addressed to Personnel Officer, ALMRL, 7 Wandsworth Road, Perivale, Middx. UB8 7JQ.

THE OPEN UNIVERSITY

Faculty of Technology

Research Technician

(£2690 - £3007 pa)

A Technician, male or female, is required to undertake work involving the Materials Science/Mechanical Engineering disciplines of the Faculty. The post holder will be required to carry out research programmes in materials studies using techniques of metallurgical testing, electron microscopy, electron scanning microscopy, X-ray diffraction and mechanical testing.

The post holder will have an ONC or GCE qualification in physics or chemistry and have completed an apprenticeship or equivalent training scheme. He/she will have at least 5 years experience of laboratory experimental/technical work and the ability to work with hand tools is essential.

Our Accommodation Officer can advise on the wide range of houses for rent and sale available in the new city of Milton Keynes.

Application forms and further particulars are available, by postcard request please, from the Personnel Manager (RT 1), The Open University, P.O. Box 1346, Walton Hall, Milton Keynes MK7 6AL, or by telephoning from Milton Keynes 58662. Closing date for applications: 25 August, 1977.

NORTH WEST THAMES REGIONAL HEALTH AUTHORITY

AUDIOLOGICAL SCIENTIST

Applications are invited for the above post from suitably qualified applicants possessing a higher degree.

The post holder will be required to work with and give advice to audiology testing centres throughout the Region, and supervise a calibration service.

In addition, the applicant will be expected to devote some time to original work in association with the Consultant ENT Specialists in the South Hams and Health District. The post is based in the Medical Physics Department at Charing Cross Hospital, London WC1X 9EE, or a similar honours degree, £3050-£3250 other degrees.

Application form and job description from District Personnel Department, Charing Cross Hospital, Fulham Palace Road, London W6 8RF. Tel: 01-748 2040 Ext. 2997. Closing date for receipt of applications 9 September, 1977.

nature

PRODUCTION EDITOR

Applications are invited for this post, which is a key position in *Nature*. (The post is vacant only because the present incumbent has just earned a major promotion.)

The Production Editor's priorities will be to maintain and, where necessary, improve production standards, also to achieve the tightest possible deadlines and turn-round of papers.

He/she will be responsible, through a small team, for the processing of manuscripts through the various stages of production. He/she will also be required to co-ordinate and plan these processes. The Production Editor will liaise with our advertising department, the Production Manager of the Macmillan Journals Company and with our typesetters.

The post is likely to suit someone with a scientific background who has been working full-time in the production side of publishing (scientific books or journals) and is looking for broader responsibilities.

Apply with curriculum vitae to:

**Dr D. Davies,
Editor of 'Nature',
Macmillan Journals Limited,
4, Little Essex Street,
LONDON, WC2R 3LF.**

(359) A

UNIVERSITY OF DURHAM Department of Chemistry

SENIOR POSTDOCTORAL RESEARCH ASSISTANT

to work on a Ministry of Defence project involving the evaluation of X-ray photoelectron characterisation (XPS/ESCA) for materials in collaboration with Dr D. T. Clark. The work will involve the application of XPS/ESCA to a wide range of problems in the surface characterisation of materials of interest to the Materials Quality Control Directorate of the Ministry of Defence. A background in either spectroscopy or materials science would be an advantage. The appointment, which will be for one year in the first instance, will commence from a date to be mutually agreed.

Salary in the range £3333-£3761 per annum plus superannuation.

Applications (5 copies) naming three referees should be sent by 15th August 1977 to Mrs J. A. G. and Secretary, Science Laboratories, South Road, Durham DH1 3LE, from whom further particulars may be obtained.

Laboratory Technicians

G. D. Searle is a major pharmaceutical company, and at its U.K. head office in High Wycombe currently has vacancies for Technicians at various levels of experience in the following departments:

Analytical Development

For analysis of samples of chemicals and mixtures according to established test procedures, and using a wide range of instrumental and classical techniques. Some familiarity with analytical methods and instruments would be an advantage. Chemistry qualification to 'O' or 'A' level required.

Apply to Mr G. Jenkins (Ref. TAD/RO9).

Reagent Production Unit

To work within a production team utilising chromatographic techniques in the purification of protein. Experience of column chromatography and centrifuge processes would be useful. ONC or 'A' level in scientific subjects needed.

Apply to Mrs S. M. Lawton (Ref. SML/2).

Clinical Chemistry

To be responsible for carrying out routine hormone assays. Qualification to 'O' level, 'A' level or ONC in a scientific subject required.

Apply to Mrs S. M. Lawton (Ref. SML/3).

A good salary will be offered and company benefits include pension and life assurance schemes, subsidised staff restaurants, social activities and free transport from surrounding areas.

Applications should be addressed to the Personnel Manager named and be sent to G. D. Searle & Co. Ltd., P.O. Box 53, Lane End Road, High Wycombe, Bucks HP12 3HL. Tel: High Wycombe 21124.

SEARLE
Research



TBA INDUSTRIAL PRODUCTS LTD.

Research & Development

TBA Industrial Products Ltd. a major manufacturer of Industrial Textiles, Glass Fibres, Belting, Gasket Material and Plastics, invite applications from Science Graduates or Associates of the Textile Institute for a position in Research and Development.

The work involves development of textile products from inorganic and high temperature organic fibres, the successful applicant becoming a member of a project team developing related products. Some liaison with the marketing and production functions will also be involved.

Experience in textiles, textile chemistry or industrial research would be an advantage, but candidates with no previous experience in these fields will be considered.

An excellent working environment in a building devoted to Research and Development is provided and sports/social activities are available.

For an application form please ring:

TURNER & NEWALL LIMITED
Mr I. Waters, on Rochdale 47422 or
write to him at TBA Industrial
Products Ltd., P.O. Box 40, Rooley
Moor Road, Rochdale OL12 7EQ.

Microbiologist £2149 - £5778 (plus supplement)

Applications are invited from both men and women for a pensionable post in the Agricultural and Food Bacteriology Division of the Department of Agriculture.

The major part of the work of the Division is in research in food microbiology and in providing courses in microbiology in the Faculty of Agriculture and Food Science, Queen's University, Belfast.

The officer appointed will be expected to undertake research and investigational work connected with microbiological quality in foods and may be required to undertake lecturing duties in the Faculty of Agriculture and Food Science, Queen's University, Belfast.

Appointment may be at Senior Scientific Officer, Higher Scientific Officer, Scientific Officer level.

SENIOR SCIENTIFIC OFFICER

Over 25 and under 32 years of age on 31 December 1977 with a 1st 2nd Class Honours Degree in an appropriate Science subject and at least 4 years' postgraduate experience in microbiology.

HIGHER SCIENTIFIC OFFICER

Under 30 years of age on 31 December 1977 with an Honours Degree as above and at least 2 years' appropriate post-graduate experience.

SCIENTIFIC OFFICER

Under 27 years of age on 31 December 1977 with an Honours Degree as above.

Exceptionally applications may be considered from candidates over the age limits who have specialised experience. Those hoping to graduate during 1977 may apply for the grade of Scientific Officer.

SALARY SCALES

Senior Scientific Officer £4185 - £5778

Higher Scientific Officer £3254 - £4454

Scientific Officer £2149 - £3527

In addition to the salary scales quoted pay supplements of between £310-59 and £522-00 per annum will be payable. Grading and starting salary will be related to qualifications and experience.

Please write or telephone for an application form quoting reference SB 213/77/NS to Civil Service Commission, Rosepark House, Upper Newtownards Road, Belfast BT4 3NR (telephone Dundonald 4585, ext. 257). Completed forms must be returned to arrive not later than 1 September 1977.



**NORTHERN IRELAND
CIVIL SERVICE**

CRYSTAL GROWTH TECHNICIAN

M.C.P. Laboratories are concerned with the preparation and small scale production of high purity materials used in the electronics industry, especially crystals grown from melts.

We need a technician with good practical skills who has a few years' experience of laboratory work involving processes at elevated temperatures. Appropriate qualifications: ONC, HNC or equivalent.

For application form please telephone or write to:

Dr J. E. Wardill, Mining & Chemical Products Ltd., Research Laboratories, Folleton Park, Winkfield, Windsor, Berkshire. Tel: Winkfield Row (STD 03447) 2935.

IBM UK SCIENTIFIC CENTRE

Local Government Resource Allocation Physical Planning and Modelling Systems Research Fellowships

IBM United Kingdom Limited wishes to appoint a number of Research Fellows to work at the UK Scientific Centre, Peterlee, on a variety of projects related to planning in the public sector.

The Centre works through the medium of Joint Research Projects with Local Authorities, Universities and other organisations.

In the present case, the projects are:-

- Manpower planning models and systems for Local Government.
- Modelling systems for use by city planners and officials.
- Physical planning systems, including Local and Structure Planning.

Suitable candidates, male or female, will possess a degree in a scientific subject—possibly operational research. They will have practical experience of developing, implementing and using models and modelling systems. Preference will be given to those whose experience is relevant to the Local Government environment.

The Research Fellows will join the Scientific Centre either as self-employed individuals or on secondment from their present employers. The appointment will be for an initial period of one year, with the possibility of renewal for a further period of up to one year. The value of a Fellowship will consist of a fee (not less than current salary), a sum equivalent to the employer's contribution to a recognised superannuation scheme and accommodation in a furnished house or flat in Peterlee.

If you are interested in applying for one of these Fellowships, please write giving details of your educational and occupational record to: Dr. D.T. Snell, IBM United Kingdom Limited, Scientific Centre, Neville Road, Peterlee, Co. Durham SR8 1EY.

Telephone: Peterlee (0783) 863322.

THE LONDON HOSPITAL
(WHITECHAPEL)

Senior Radiographer— Radioisotopes

Applications are invited from Radiographers experienced in Clinical Radioisotopes for the above appointment at this busy department. The equipment used in this busy department includes a Gamma camera and two electron accelerators. The department handles liquid and caesium and the post will be either on the Senior I or II grade according to experience.

Good staffing facilities on site include an active social life, a swimming pool and tennis courts, staff restaurant and library. Season tickets less scheme. Temporary single accommodation may be available.

Applications for availability to: Miss S. E. Woodhouse, The Personnel Services Department, The London Hospital, Whitechapel, London E1BB, (Tel: 01 547 5454 ext. 380).

Tower Hamlets Health District part of The City & East London AHA (T).

THE ROYAL VETERINARY COLLEGE

University of London
Department of Medicine,
Hawkshead Lane,
North Mymms,
Hatfield, Herts

TECHNICIAN GRADE 4

REQUIRED TO OPERATE HISTOLOGY LABORATORY AS PART OF A SERVICE TO DIAGNOSIS AND RESEARCH. MODERN EQUIPMENT INC. FREEZER, COOLER, CRYOSTAT, ETC. AND WORK FROM VARIED SOURCES INCLUDING DERMATOLOGY, NEUROLOGY AND ENTEROLOGY. THE POSITION IS SOMETHING RELATED TO UNDERGRADUATE TEACHING.

APPLICANTS SHOULD HAVE AT LEAST FIVE YEARS' RELEVANT EXPERIENCE AND PREFERABLY ISTC/CITY AND GUILDS OR IMLT QUALIFICATION.

PLEASANT SURROUNDINGS. SUPER-ANNUATION SCHEME. SALARY SCALE: £2975 TO £3375 P.A.

FOR FURTHER DETAILS PHONE G. W. SPENCER, 01 580 5222 OR 01 584 6666 AFTER 14 AUGUST.

APPLICATION FORMS AVAILABLE NOW FROM ASSISTANT SECRETARY (PERSONNEL), THE ROYAL VETERINARY COLLEGE, COLLEGE STREET, LONDON NW1 0TU.

SUNDERLAND POLYTECHNIC

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICAL SCIENCES

RESEARCH ASSISTANTSHIP IN PHYSICS

REQUIRED TO INVESTIGATE PROBLEMS IN THE AREA OF MICROWAVE ACOUSTICS. CANDIDATES SHOULD HAVE A GOOD HONOURS DEGREE.

THE SUCCESSFUL APPLICANT WILL BE EXPECTED TO REGISTER FOR A HIGHER DEGREE. THIS APPOINTMENT IS FOR TWO YEARS IN THE FIRST INSTANCE, WITH THE POSSIBILITY OF AN EXTENSION.

THE SALARY FOR RESEARCH ASSISTANTS IS £2091, £2126, £2243 PLUS £444 PLUMES AND SUPERANNUATION.

AN APPLICATION FORM AND FURTHER DETAILS MAY BE OBTAINED FROM THE PERSONNEL OFFICER, SUNDERLAND POLYTECHNIC, COLLEGE ROAD, SUNDERLAND SR1 3SD, AND SHOULD BE RETURNED AS SOON AS POSSIBLE.

REDFISSION ENGINEERING LIMITED LIBRARIAN

REQUIRED TO TAKE CHARGE OF TECHNICAL LIBRARY OF RESEARCH DIVISION, WHICH WILL INVOLVE OWNERSHIP OF TELEVISION DISTRIBUTION SYSTEMS AND TO PROVIDE A LOAN AND INFORMATION SERVICE TO OTHER COMPANIES IN THE REDFUSION GROUP.

GOOD WORKING CONDITIONS WITH PROFESSIONAL PERSONNEL AND PLEASANT SURROUNDINGS IN THE RAYNES PARK, NEW HILTON AREA OF LONDON.

FOR FURTHER INFORMATION ON THIS VACANCY, PLEASE TELEPHONE OR WRITE TO: MRS A. MARTIN, LIBRARIAN, REDFUSION ENGINEERING LIMITED, 187 LONDON WEST, KINGSTON-UPON-THAMES, SURREY KT2 7DJ. TEL: 01-942 8800, EXT. 273.

ROYAL FREE HOSPITAL SCHOOL OF MEDICINE

(UNIVERSITY OF LONDON)

JUNIOR TECHNICIAN

FOR GENERAL LABORATORY DUTIES IN THE MEDICAL PHYSICS DEPARTMENT, ROYAL FREE HOSPITAL, 17 QUEEN'S ROAD, SALISBURY, WILTSHIRE, SP2 8理解. ACCORDING TO AGE AND QUALIFICATIONS. OPPORTUNITIES FOR INDEPENDENT RESEARCH BY QUALIFIED SCIENTISTS. R.F.H.S.M., 8 HUNTER STREET, LONDON WC1N 1BP. TELEPHONE 01-837 5385 EXT. 8.

PLEASE NOTE

BECAUSE OF THE AUGUST BANK
HOLIDAY, COPY DATE FOR

SEPTEMBER 1 ISSUE
IS
NOON FRIDAY
AUGUST 26

Drilling Manager

West Africa

Taylor Woodrow International require an experienced Drilling Manager to take control of a number of contracts in West Africa. Applicants must have experience of water well drilling and testing overseas, with emphasis on drilling rotary mud, foam, air flush and hammer techniques.

The successful candidate will have extensive geological and hydrological knowledge, and be prepared to train, as well as supervise, the indigenous labour under his control.

Salary is paid free of tax, with free accommodation, and home leave on full overseas pay.

Please apply in writing to David Knowles,
Taylor Woodrow International Ltd., Western
House, Western Avenue, London W5 1EU.

**Taylor
Woodrow**



Toxicologists

Continued site development has created openings for two experienced graduates to join our team evaluating the safety of novel therapeutic compounds and thereby assist in the development of new drugs.

In addition to a degree in an appropriate biological science, such as Pharmacology or Physiology, applicants should possess not less than two years' relevant practical experience.

In return, we offer a competitive salary and the fringe benefits associated with a major company. The Medicinal Research Centre is pleasantly located close to both London and Cambridge and unfurnished Development Corporation housing may be available at an economic rent.

Please write, outlining your career to date, to:

John Atkinson, Site Personnel Officer, Beecham Pharmaceuticals Research Division, The Pinnacles, Harlow, Essex, or telephone Harlow (0279) 419373 for an application form.

**Beecham
Pharmaceuticals**

Animal Nutritionists

Applications are invited from both men and women for pensionable posts in the Agricultural and Food Chemistry Research Division of the Department of Agriculture located at Newforge Lane, Belfast.

The successful applicants will join a team engaged in research in the various aspects of herbage conservation and animal nutrition. They may also be required to undertake lecturing duties in the Faculty of Agriculture and Food Science, Queen's University, Belfast.

Appointment may be at Senior Scientific Officer, Higher Scientific Officer or Scientific Officer level.

SENIOR SCIENTIFIC OFFICER

Over 25 and under 32 years of age on 31 December 1977 with a first or second class Honours Degree in Chemistry, Biochemistry or Agricultural Chemistry and at least 4 years' appropriate postgraduate experience in research and/or teaching, preferably in relation to animal nutrition.

HIGHER SCIENTIFIC OFFICER

Under 30 years of age on 31 December 1977 with an Honours Degree as above and at least 2 years' appropriate post-graduate experience.

SCIENTIFIC OFFICER

Under 27 years of age on 31 December 1977 with an Honours Degree as above.

Exceptional applications may be considered from candidates over the age limits who have specialised experience. Those hoping to graduate in 1977 may apply for the grade of Scientific Officer.

SALARY SCALES

Senior Scientific Officer £4185 — £5778

Higher Scientific Officer £3254 — £4454

Scientific Officer £2149 — £3527

In addition to the salary scales quoted pay supplements of between £310-59 and £522 per annum will be payable. Grading and starting salary will be related to qualifications and experience.

Please write or telephone for an application form quoting reference SB 212/77/NS to Civil Service Commission, Rosepark House, Upper Newtownards Road, Belfast BT4 3NR (telephone Dundonald 4585, ext. 237). Completed forms must be returned to arrive not later than 2 September, 1977.



**NORTHERN IRELAND
CIVIL SERVICE**

Harrow College of Technology and Art

Science Technician

up to £3658

For the College Microbiology Laboratory where the duties will include the preparation of materials and equipment for practical classes mainly at HNC level. Applicants (men or women) must possess City and Guilds Laboratory Technicians Certificate or equivalent with relevant experience.

Application form from:—Chief Administrative Officer, Harrow College of Technology and Art, Northwick Park, Harrow. Tel. 864 4411, ext. 31, returnable within 14 days.

Harrow Education



Graduates to Train as Information Officers Ware, Herts

Two vacancies exist in our Science Information Department for recently qualified graduates with a sound training in immunology, microbiology or another biological discipline which is relevant to the Pharmaceutical Industry.

The successful applicants will provide an information service to a multi-disciplinary group. This will include current awareness and retrospective literature searches.

Previous experience of information work is not essential as the necessary training will be given. However, candidates must be able to communicate with staff at all levels throughout the Company.

The position carries an attractive salary, other benefits include flexitime working, pension and profit sharing schemes.

Applications should be made to:

R. A. Axe,
Assistant Personnel Officer,
Allen & Hanburys Research Ltd.,
Ware, Herts. SG12 0D.J. Telephone Ware 3232.



**Allen & Hanburys
Research Ltd.**



Medical Research Council

ELECTRON MICROSCOPIST

Applications are invited for an electron microscopist to conduct research into the ultrastructure of the lung and its cells and their response to dust and other toxic material. Experience in the biological use of the electron and transmission electron microscope is essential. Training in pathology would be an advantage. Both medical and non-medical backgrounds are considered and the appointment will be to the Scientific Staff in the salary band £3761-£5219 (inclusive of pay supplements) according to age, qualifications and experience.

Applications to include the names and addresses of two referees to The Director, MRC Pneumoniology Unit, University of Wales College of Cardiff, Porthcawl, South Glamorgan CF6 1XW.

FRESHWATER BIOLOGICAL ASSOCIATION

FISH BIOLOGIST/ HYDROLOGIST

Applications are invited for two four-year term appointments for (a) a biologist to study the effects of flow regimes on the egg and young of salmonids, and (b) a hydrologist, engineer or physicist to study the effects of flow regimes on salmonids.

The successful applicants will be members of a team working near Barnard Castle, Co. Durham. Candidates should have a good honours degree and relevant experience. The posts are graded SO (£3073-£4048) or exceptionally HSO (£4048-£4975) depending on experience.

Details and application forms are obtainable from: The Secretary, Freshwater Biological Association, The Cherry House, Ambleside, Cumbria LA22 0LF, before 23 August, 1977.

BRITISH ANTARCTIC SURVEY

Period appointments for up to three years
(mostly in Antarctica)

Expedition Personnel

are required to operate and maintain scientific radio equipment in Antarctica used for remote sensing of the ionosphere and magnetosphere. Applicants should have a background in electronics and physics with practical experience in the maintenance and repair of solid state and valve circuits. The successful candidate must be prepared to work without supervision and be capable of improvisation under adverse situations. Opportunities exist for suitable qualified staff to engage in original research in UK on completion of field duties. Preference will be given to candidates with a degree or Higher National Diploma in electronics and/or physics, but City and Guilds certificates in electronics subjects or relevant military qualifications will also be considered.

Successful candidates will be required to commence a training course as soon as possible prior to sailing for Antarctica in September or October. The period of field service is about two and a half years.

Applicants must be single, aged 21-35, physically fit and male, (the bulk of the duties being necessarily carried out overseas with only training performed in the UK). Salary is from £2480 per annum depending on qualifications and experience, with annual increments. Income tax is low, polar clothing and messing are free, whilst overseas.

For further details and an application form, please write stating full qualifications and experience to:

The Establishment Officer, British Antarctic Survey,
Madingley Road, Cambridge CB3 0ET.

Please quote Ref: BAS 58.

Closing date: 23 August 1977.

NATURAL ENVIRONMENT RESEARCH COUNCIL

BOARD OF GOVERNORS— ST. PETER'S HOSPITALS

Social Investigator

required by St. Peter's Hospitals, WC2 to help in the discovery of risk factors in benign bladder cancer and working environment. Research experience in a similar or related field would be invaluable as would experience of in-depth interview techniques.

The successful applicant will possess a degree in Social Science (or related field), a knowledge of statistics and preferably, have studied chemistry to A-level standard.

This is an extremely interesting new post requiring personal qualities such as patience, the ability to work effectively in a multi-disciplinary team, and the initiative to develop and expand the work of the unit without constant supervision.

Salary negotiable from around £3000 p.a. For further details and application form, please contact: Richard Parkhouse, Personnel Department, St. Philip's Hospital, Shaftesbury Street, WC2. (Tel—242 9831 extn 38).

BRISTOL POLYTECHNIC

Department of Construction and Environmental Health
LECTURER GRADE II/
SENIOR LECTURER IN
ENVIRONMENTAL HEALTH

Candidates should be graduates in Environmental Health or a related discipline with appropriate professional qualifications and experience.

The successful candidate will be expected to contribute to a new degree course in Environmental Health and other related courses in the department. Previous teaching experience is not essential. The ability to contribute to research in the department would be an advantage.

Salary Scale £3279-£5051 (bar)—
£5955 (£6417 plus £121 plus
Phase Two award).

Further details and application form to be returned by 26 August, 1977 to Personnel Officer, Bristol Polytechnic, Coldharbour Lane, Bristol BS1 5WT. Please quote Post Reference number L53/58 in all communications.

UNIVERSITY OF BATH RESEARCH OFFICER

Research Officer required for a one year term, to "The Institute of Freshwater and Coastal Processes (Pollution Control)". Candidates will be expected to have a good first degree in a science or economics related subject and preferably post-graduate or industrial experience.

Salary according to age and qualifications up to £3761. Application forms available from the Personnel Officer, University of Bath, Claverton Down, Bath quoting reference number 77/689. Closing date will be Friday 26 August, 1977.

THE UNIVERSITY OF LIVERPOOL

Department of Botany
TECHNICIAN

Required to assist mainly in the practical classes in plant physiology. Some knowledge of chemistry, solvents, making up reagents etc. would be an advantage. Minimum qualifications: O.N.C. Salary in a range up to £2600 per annum. Application forms may be obtained from the Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote Ref. RV/520/NS.



SMITH & NEPHEW RESEARCH LTD

has an opportunity for an

INFORMATION SCIENTIST

to widen his/her range of experience in technical information work.

The person appointed will be expected to work closely with the Research and Development Teams in advising on and contributing to technical information relating to current projects. There will be some responsibility for existing library systems and for evaluating new advances in the information field—currently the company wishes to assess the application of on-line systems.

Candidates must hold a degree in a relevant scientific discipline and have some years' experience in information work. A post graduate qualification in Information Science would be an advantage. Probable age 25-30 years. Smith and Nephew is internationally well known in the field of medical products and the Research Company has an excellent record of innovation and development. The research laboratories are situated in a pleasant countryside location just outside Harlow, Essex, within easy reach of London and Cambridge. Terms and conditions of employment are those expected of any large British company.

Please apply in writing to
Mrs P. D. Harrison,
Smith & Nephew Research Ltd.,
Gilston Park, Harlow, Essex.

AUDIOLOGICAL and PSYCHOACOUSTIC RESEARCH

Applications are invited for appointment to a research project at the Institute of Hearing Research. The Institute's Headquarters are in the Medical School, University of Nottingham, and the post will be based in one of the Institute's hospital units. The postholder will be required to make some regular travel, will also be involved in methods for gathering data on sensory discrimination and in advanced displays for evaluating the performance of hearing impaired patients and their potential for further hearing advantage. The main initial project will involve comparing normal-hearing and severely hearing impaired subjects on multiple psychoacoustic measures as well as desk-top investigations. The postholder will be in close collaboration with those working on epidemiology of hearing impairment and on hearing aids. Applications are invited to contribute to national discussions on standardization of new specific audiometric tests.

The appointment will be on the Grade 1 or Grade II scale for academic staff (£3781-£5211 p.a. for Grade II), according to qualifications, age and experience. If aged under 27, the contract will be for 3 years; older research students will be appointed for 3 years in the first instance with the possibility of further extension. Applications for a more senior scientific appointment of unlimited duration may be considered. Interviews will be held on 15 September 1977. Applications should be sent by 30th September 1977.

NORTH-HOLLAND PUBLISHING COMPANY AMSTERDAM

have a vacancy for a

DESK EDITOR PHYSICS

The position concerns the in-house desk-editorial handling of scientific journals, which includes the technical editing of manuscripts for the printers, proof correction, making up of issues, and correspondence with authors and editors.

After an initial training period, the successful applicant must be able to function with a high degree of independence. He/she should have:

- at least two years' university-level physics and/or experience in technical editing,
- a good command of English and the ability to express him/herself clearly,
- an eye for detail and style.

As a subsidiary of Associated Scientific Publishers, we belong to the Elsevier group. This group's excellent fringe benefits will apply to the post, in addition to a competitive salary, dependent on the applicant's qualifications.

Letters of application with full CV and an indication of present or expected salary, should be directed to: The Personnel Dept., A.S.P., PO Box 2400, Amsterdam, The Netherlands.

Information Specialist

£3777 to £5027*

The Electricity Council is the central co-ordinating body for the electricity supply industry in England and Wales.

We are seeking an Information Specialist to join a small multi-disciplinary team which undertakes briefing and deals with enquiries on the technical, economic and commercial aspects of electricity distribution and utilisation and produces abstracts, summaries and bibliographies, publications on fuel subjects, and a wide range of statistics.

The duties of the post will be abstracting mainly from technical periodicals and assisting with inquiries and information searches.

Applicants should have a degree in science or technology, a good writing style and experience in information work. A knowledge of the fuel sector and of technical German would be advantageous.

*There is a further salary supplement of 5% of taxable pay for the month concerned subject to maximum supplement of £17.38 and a minimum supplement of £10.86.

Please write in confidence giving age, career to date, and present salary quoting ref: NS/105 by 25th August to: Duncan Ross, Recruitment & Development Officer, The Electricity Council, 30 Millbank, London SW1P 4RD.

ELECTRICITY COUNCIL

POST-DOCTORAL ASSISTANTS AND RESEARCH STUDENTS

Required to form a small team of engineers working towards a better understanding of the flow, heat transfer and combustion processes in gas turbine combustors.

Location

Mainly in the departments of chemical and mechanical engineering at Imperial College. The project will be carried out in close collaboration with Rolls-Royce Limited and the National Gas Turbine Establishment and short periods will be spent at each of these establishments.

Qualifications

Two posts require qualifications to doctorate level with experience of combustion and/or experimental work relating to fluid dynamics, convective heat transfer or combustion.

Two posts require a good honours degree and desire to research in the above topics and an enthusiasm for hard work are essential.

Salary

Post-doctoral assistants will be paid according to research staff IA scale with London allowance. Research students will be paid at current SRC rates.

Applications

Write with brief statements of relevant experience and qualifications to: Professor J. H. Whitelock, Department of Mechanical Engineering, Imperial College of Science and Technology, London SW7 2BX.

Product Development in Food and Drinks

Beecham Products have opportunities for chemists, food technologists and nutritionists to become involved in research and development work for this major progressive Company. The vacancies are in our Research Laboratories at Coford in the Forest of Dean, Gloucestershire, and at Slough in Berkshire. We require several honours graduates with up to three years relevant post graduate experience and also two section leaders with at least five years experience in the Food industry.

Successful applicants, male or female, will be given clearly

defined responsibility for specific projects and will work directly with Marketing and Production personnel. Assignments will be selected and changed as part of a planned programme of career development.

Please write or telephone for an application form, indicating which location you prefer, to

David Short, Personnel Manager (Central Services), Beecham Products, Beecham House, Great West Road, Brentford, Middx. Tel: 01-560 5151. Ext. 2197 or 1095.

Beecham Products 

IMPERIAL CANCER RESEARCH FUND Lincoln's Inn Fields Laboratories and Medical Oncology Unit, St. Bartholomew's Hospital

A POST DOCTORAL CELL BIOLOGIST or IMMUNOLOGIST

with previous experience or interest in cell culture techniques is required, to join a group working on experimental aspects of human neuroblastoma. The appointment will be for 2 years in the first instance with possible extension of 1 year. Salary will be within the range £1862-£4695 plus £600 London Weighting, plus a salary supplement per year, with entry according to qualifications and experience.

Applications with curriculum vitae and names of two referees should be sent to: The Secretary, Imperial Cancer Research Fund, P.O. Box 123, Lincoln's Inn Fields, London WC2A 3PX from whom further information may be obtained.

Closing date 23 September 1977.

TRINITY HOUSE LIGHTHOUSE SERVICE

Applications are invited for appointment as Scientific Officer in a small group engaged in operational research.

Qualification required: five 'O' levels, including maths and physics, plus working knowledge of electronics.

Salary (including Inner London Allowance and Pay Supplement of £8 p.w.) commences at £927-20 p.a. thereafter, in steps, to £1110-20 p.a. A further supplement of 5% to a maximum of £4 p.w. is also paid. Further details and application form available from the Establishment Officer, Trinity House, Tower Hill, London EC3N 4DH.

INSTITUTE OF TERRESTRIAL ECOLOGY

A SO/HSO is required to join a small team of biometricalists in the Cambridge office of the ITE.

The successful applicant will eventually be required to design systems studies of a wide range of ecological situations and to lead small teams of ecologists in producing mathematical models and in providing advice on experimental design to scientists throughout the Institute.

Qualifications/Experience

Candidates should be experienced in the use of mathematical models in ecological research and have a background in mathematics or statistics or, exceptionally, in a biological subject with post-graduate training in mathematics or statistics. There is a liability to travel widely throughout the United Kingdom and, possibly, overseas.

Applicants should have a first or second class honours degree or equivalent qualification.

Salary/Conditions of Service

Starting salary according to age, qualification and experience on one of the following scales:

SO £2149-£3527 HSO £3254-£4454

Plus supplements of £313-20 pa and appropriate Phase II (£130-50-£208-80 pa). Non-contributory superannuation scheme.

Application forms and further information may be obtained from:

Establishments Section
Institute of Terrestrial Ecology
88 Hills Road, Cambridge CB2 1LA
Telephone (0223) 69745

The closing date for completed applications is 5 September 1977.

NATIONAL ENVIRONMENTAL RESEARCH COUNCIL

UNIVERSITY OF DUNDEE DEPARTMENT OF BIOLOGICAL SCIENCES

Applications are invited from honours graduates in Biology, Botany or Microbiology for the post of

RESEARCH ASSISTANT

to work with Dr K. M. Old in the above Department on an investigation concerned with the lytic of spores and the effect of heat on soil bacteria. The post, which is supported by a NERC grant, is available for 3 years from 1 October, 1977 and the starting salary will be dependent on qualifications and experience within the range £2904-£3332.

Applications, by letter accompanied by curriculum vitae and the names and addresses of two referees, should be sent as early as possible to the Secretary, The University, Dundee DD1 4HN. Please quote reference Est/38/77H.

KING'S HEALTH DISTRICT (TEACHING)

The Division of Pathology have a post available in the Department of Chemical Pathology for a

TECHNICIAN OR A JUNIOR TECHNICIAN

The department offers an extensive range of facilities and there is in operation a comprehensive in-service training programme. Applicants should possess either the Higher National Certificate in medical laboratory sciences or an appropriate degree or equivalent qualifications plus the State Registration Board.

Successful candidates will be encouraged to study for the appropriate examinations to gain Fellowships of the Institute of Medical Laboratory Science.

Applicants should write to: The Principal Technician, Division of Pathology, King's College Hospital, Denmark Hill, London SE5.

UNIVERSITY OF MANCHESTER

Department of Pharmacy
Pharmaceutical Sciences—
Pharmacokinetics

Applications are invited for this post, commencing October 1977, to work on an MRC supported research project investigating the interaction of various drugs with one another, drugs in animals and in man. The work involves, and experience is desirable in, chemical analysis, pharmacokinetics, organic chemistry. Initial salary up to £5761 p.a. Superannuation. Applications, accompanied by curriculum vitae and names of two referees to be sent as soon as possible. Professor M. Rowland, Department of Pharmacy, M13 9PL.

WESTFIELD COLLEGE (University of London) TECHNICIAN GRADE 3 (TWO POSTS)

Two Technicians Grade 3 are required to work in the Department of Botany and Biochemistry. Duties will include preparation for classes in Botany and Cell Biology, care and maintenance of apparatus, equipment, and some research involvement. Applicants should be suitable for appointment on probationary salary within the range £2465 to £2811 plus £465 London Weighting. Further details from, and application form available from the Personnel Officer, Westfield College (NS), Kidderpore Avenue, Hampstead, London NW3 7ST by 24 August, 1977.

UNIVERSITY OF CAMBRIDGE

**Research Assistant
Post in the
Cavendish Laboratory**

Applications are invited for two posts of postdoctoral Research Assistant in the Laboratory's Astrophysics group at the Cavendish Laboratory to undertake experimental studies on galactic microwaves and radio galaxies.

One post is for the development of equipment to investigate the mechanisms of the inversion of populations in hydroxyl molecules using the technique of spectroscopy, and the other involves the investigation of methods of producing a tunable source for spectroscopy in the far-infrared.

Each post is for two years and is pension-eligible. Remuneration will be at the start as soon as possible. The salaries are a scale to £4607 p.a. Applications concerning a curriculum vitae and the names of two referees should be sent to the Secretary, The Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE.

UNIVERSITY OF
MANCHESTER

Department of Chemistry

Applications are invited for the post of

TECHNICIAN

in the Spectroscopy Laboratory of the Chemistry Department. The post is primarily for the operation of NMR spectrometers and experience in this field would be advantageous. Other candidates with experience in spectroscopy (IR, UV or MS) of other instruments and techniques would be considered, in which case training would be given.

Commencing salary within range £2453-£3008 p.a. depending on experience and qualifications.

Applications should be sent as soon as possible to the Laboratory Secretary, Department of Chemistry, The University of Manchester, Manchester M13 9PL.

MATERIALS TECHNOLOGISTS

Redland Technology serves the multi-national Redland Group of companies which is concerned with the manufacture of building and construction materials.

The New Technology and Product Development Centre, Chelmsford, requires two male or female applicants to carry out research and development studies on new building materials and to give technical support for existing products.

Applicants should have an interest in ceramics, physical inorganic chemistry, silicate chemistry or concrete, previous experience in one of these fields will be an advantage but is not essential.

Salary will be negotiable depending on experience and qualifications. There are good career prospects in a young and developing department.

Please reply to: Dr. R. Bailey, Redland Technology Limited, Graylands, Horsham, Sussex.

THE UNIVERSITY
OF SHEFFIELDDepartment of Metallurgy
POST-DOCTORAL
RESEARCH ASSISTANT
(SRC)

required for studies on aerosol condensation using visible and infrared laser techniques. Salary in range £3533-£3975 plus supernumerary provision. Enquiries from phys. chemists, chemical engineers, metallurgists and materials scientists to Dr E. R. Buckle, Department of Metallurgy, The University, Sheffield S1 3JD. Quote Ref. B16/II.

**Research
Engineer
Hampshire**

This appointment with the Company's Research and Development Centre in Southampton is a first class opportunity to make a career with a large international company with a broad based development programme centre in the U.K. The prime requirement will be to design and develop new processes in cigarette manufacture. The problems are challenging and the work involved will be varied and embraces most aspects of engineering. Development facilities, workshop and support services are excellent. Overseas travel may be involved although on an intermittent basis. The successful applicant, aged about 25 years, will possess a good honours degree, and also have some relevant experience in a process-type industry. Self motivation, together with initiative and drive to carry projects through to their completion are essential personal qualities.

Salary ranges are very competitive and the starting salary will be commensurate with qualifications and experience. Other benefits are well in keeping with those of a multi-national company including Pension Fund, holiday entitlements, Flextime working and re-location expenses.

Candidates, male or female, should write or telephone please, for an application form to:

Personnel Department (Folio 63),
Group Research &

Development Centre,
British-American Tobacco Co. Ltd.,
Regents Park Road, Millbrook,
Southampton SO9 1PE.

Tel: Southampton (0703) 777621.

 **Group
Research
and Development
Centre**

SCIENTIFIC OFFICER

required for our Technical Department within a large papermaking production unit at the Dartford site.

The successful applicant will gain experience, initially, under the guidance of Project Leaders, with the view to promotion after a period of six months.

Appropriate training will be given within the Group to broaden knowledge of the Company and its products.

Applicants, male or female, must have a science degree and be seeking a progressive career within the papermaking industry.

Please telephone, or write, for an application form to Mr. F. A. Ralph, Dartford 23411.

**WIGGINS TEAPE LTD.,
PRIORY ROAD,
DARTFORD,
KENT**



**ROTHAMSTED
EXPERIMENTAL STATION**
Harpenden, Herts, AL5 2JQ
The Soil Survey of England and
Wales (Norwich Centre)
requires a

**SCIENTIST
TO MAP SOILS**

Candidates should have an honours degree (lower second class) or equivalent in chemistry, geography, soil science or environmental science.

Appointment in grade of Scientific Officer, salary scale £2149-£3527 p.a., point of entry depending on qualifications and experience. Supplements totalling £442 to £521 p.a. are also payable. Non-contributory superannuation.

Apply in writing to The Secretary giving names and addresses of two referees and quoting Ref. 327 by 2 September, 1977. Further details on request.

UNIVERSITY OF BRISTOL
Department of Biochemistry
RESEARCH ASSISTANT

Applications for the above post are invited from graduates in Biochemistry or related subjects. The group studying various aspects of the control of nitrogen metabolism in rat liver and the control of amino acid transport across the liver cell plasma membrane. The post is funded by the Medical Research Council and is available for up to three years. Salary will be on the Research Assistant scale £2904-£3533 per annum.

Applications in writing stating age, qualifications and experience, and giving the names of two referees should be sent as soon as possible to Dr. D. M. Morris, Department of Biochemistry, Medical School, University Walk, Bristol BS8 1TD.

KING'S HEALTH DISTRICT
MEDICAL PHYSICS
TECHNICIAN III

Interesting and varied work in the Regional Neonatal Intensive Therapy Unit at this London Teaching Hospital to look after monitoring and life support equipment used for the care of seriously ill newborn babies, and also to develop new types of equipment.

Applicants should have a minimum qualification of ONC preferably HNC (or equivalent).

Salary £3776-£4708 depending on experience and qualifications. Further details and application form from the Hospital Administrator's Office, King's College Hospital, Denmark Hill, London SE5 9RS. Tel: 01-274 6222 Ext. 2408.

UNIVERSITY OF
MANCHESTERDepartment of Physics
RESEARCH STUDENTSHIP
FOR THE STUDY OF
POLYMERS BY LASER
LIGHT SCATTERING

Applications are invited for a Research Studentship sponsored by the ICI Ltd. to study polymer systems by laser light scattering and other techniques and in particular photon correlation. The work proposed would be suitable for physicists or chemists with a first or upper second-class degree. Applicants should contact Dr. T. J. L. Smith, Physics Department, The Schuster Laboratory, The University, Manchester M13 9PL. Tel: 061-273 3555. Ext. Physics 30.

UNIVERSITY OF MANCHESTER
PHARMACY DEPARTMENTPOST-DOCTORAL
RESEARCH ASSISTANT
(M.R.C.)

Applications are invited for a post-doctoral research assistant for work in collaboration with Dr D. Attwood (Pharmacy Department, University of Manchester) and Dr E. Wyn-Jones (Chemistry Department, University of Salford). The project involves a study of the interaction of drugs with membranes in aqueous solutions of drugs which exhibit colloidal behaviour, using both kinetic and equilibrium techniques.

Salary up to £1761 p.a. on Range 1A plus superannuation. The post is the first tenable for one year from 1st October 1977 or from an agreed date. Applications, quoting by letter, including a curriculum vitae and the names of two scientific referees to Dr D. Attwood, Pharmacy Department, Manchester University, Manchester M13 9PL.

UNIVERSITY OF SURREY
Biochemistry Department
RESEARCH OFFICER

An immediate vacancy exists for a person, preferably with experience in clinical biochemistry, to join a small group engaged in the use of radioimmunoassay to measure blood drug levels in leukaemia patients.

The post is available for three years with a starting salary of £2904 per annum.

Application forms may be obtained from the Staff Officer, University of Surrey, Guildford, Surrey GU2 5XH, or Tel: Guildford 71281, Ext. 452 and these should be returned by 29 August, 1977.

GUY'S HOSPITAL
MEDICAL SCHOOL
(University of London)Graduate Research
Assistants

preferably a recent Physics graduate, required initially for 2 years to join a research team under Professor T. J. H. Green in the Radiotherapy Research Unit. Salary, in Range £2926-£4199 (October 1976 scale) plus £450 London Allowance and superannuation.

Applications with c.v. and the names of referees to the Secretary, Guy's Hospital Medical School, London Bridge SE1 1LT, from whom further details may be obtained. Please quote Ref. R.F.1.

THE UNIVERSITY OF
MANCHESTER
TEMPORARY LECTURER
IN PHYSIOLOGY

Applications invited for this one-year post from candidates with a high degree in a discipline of related subjects, or medical qualifications registrable in UK. The appointee will teach medical, dental and science students at the excellent research facilities. Salary range p.a. £3335-£3975. Particulars and application forms (returnable by 22 August) from the Registrar, The University, Manchester M13 9PL. Quote ref: 142/77/NS.

Editing Staff
"The Practitioner"

Assistant Editor

"The Practitioner", the journal of postgraduate medicine, has a vacancy for an Assistant Editor who will be responsible for all aspects of the Journal's production from liaison with contributors to maintenance of the publishing schedule and supervision of the Technical Sub-Editors. This will involve the preparation and proofreading of all articles, liaison with the journal design department and the printer.

Applications are requested from candidates with a medical and/or scientific qualification who should have experience in one of these fields and in technical publishing. Facility in the use of the English language and complete familiarity with medical and scientific terminology are essential requirements.

Technical Sub-Editor

To be responsible for the preparation of all material for publication through all the stages for printing. This will include page make-up with the journal design department.

Applicants should have a medical and/or scientific background and be familiar with medical terminology. A thorough grounding in the English language is an essential requirement.

These posts are open to both men and women and as well as a competitive salary, 4 weeks' holiday per annum (rising to 5 weeks with service), subsidised staff luncheon club, contributory pension scheme with free life assurance are amongst the benefits offered as a part of the Morgan-Grampian group.

Applications with curriculum vitae should be addressed to Dr H. L'Estrange, Editor, "The Practitioner", Morgan-Grampian House, 30 Calderwood Street, London SE18 6DH.

ST. GEORGE'S HOSPITAL
MEDICAL SCHOOL
(University of London)

ELECTRONICS TECHNICIAN required for interesting and varied work in the Department of Psychology and Pharmacology of the new Medical School. Both Departments have research interests involving electronic biological recording apparatus linked to laboratory computing systems. The post would be suitable for someone with relevant experience in electronics and experience with similar electronic equipment, who could be appointed at the Grade 6 level. Longer term career prospects may be considered for appointment at a lower grade, with the possibility of promotion after a trial period. The post would be suitable for developing interests in the area of mini-computers, including programming. Applications from the Establishment Officer, St. George's Hospital Medical School, Crammer Terrace, London SW17 0RE. Please do not telephone.

UNIVERSITY OF DURHAM
Department of Physics

Applications are invited for the post of
RESEARCH ASSISTANT with a group involved in the measurement of optical linear polarisation in galaxies and gaseous nebulae. The applicant should have a Ph.D. and at least two years of further experience. The applicant should have a background in theoretical astronomy and will be expected to work on the interpretation of the polarimetry data.

The position is for two years starting in October or as soon as possible thereafter.

Starting salary in the range £3335 to £3975 on National Research Range 1A plus superannuation.

Applications (3 copies) naming three referees should be sent by 2 September, 1977, to the Registrar and Secretary, Scientific Laboratories, South Road, Durham DH1 3LE, from whom further particulars may be obtained.

UNIVERSITY OF OXFORD
Genetics Laboratory

Department of Biochemistry
Ref. G5

GRADE 5 TECHNICIAN

Applications are invited for a post of technician to take charge of the work in the Genetics Laboratory, Dept. of Biochemistry, University of Oxford. Work will be mainly concerned with tissue typing of the genetics of human blood antigens. This involves the genetics of antisera for research purposes, tests for tissue typing, cell culture, cell lines, possibly the immunisation of small animals and growing of tissue cultures. The organisation of tissue culture and tissue typing laboratory and co-ordination with other groups is an important feature of the job. Biological or biochemical laboratory is essential. Preference may be given to candidates with experience in tissue typing laboratories and to those with HNC, AIMLT or equivalent qualifications. Salary range £2889-£3367 p.a.

Applications stating experience and qualifications and names of two referees, should be sent by 31 August, 1977, to The Administrator, Dept. of Biochemistry, South Parks Road, Oxford OX1 3QU.

UNIVERSITY OF SURREY
DEPARTMENT OF
BIOCHEMISTRY
RESEARCH
OFFICERS

Applications are invited for TWO RESEARCH OFFICERS to undertake research into factors affecting the development of lung cancer. Recent graduates will be considered and preference will be given to applicants with postgraduate experience in at least one of the following fields.

Cell suspension and culture
Biochemical assays
Use of radioactive isotopes

The work is supported by the Medical Research Council, the Cancer Research Campaign and the positions are tenable for 3 years from 1st October 1977. Salary £2904-£3333.

Applications with a curriculum vitae and the names and addresses of two referees should be sent to the Staff Officer, University of Surrey, Guildford, Surrey GU2 5XH before 1 September.

Further particulars may be obtained from Dr G. M. Cohen, Department of Biochemistry, University of Surrey, or tel. Guildford 71281, Ext. 621.

ROYAL POSTGRADUATE
MEDICAL SCHOOL
University of London

TECHNICIAN required to participate in a research programme on the distant spread of cancer. The work involves histological, electron microscopical and tissue culture studies and some experience of at least one of these techniques is essential.

The post would be suitable for a technician with HNC plus 2 or 3 years post qualification experience or for a newly qualified graduate.

Salary according to age and experience on scale up to £3677 per annum.

Applications, enclosing a curriculum vitae, to the Personnel Officer, R.P.M.S., 150 Du Cane Road, London W12 0HS, quoting ref. no. 6/201/NS.

AGRICULTURAL
RESEARCH COUNCIL
FOOD RESEARCH INSTITUTE

**RESEARCH
ASSISTANT**

Applications are invited for the post of Research Assistant in the Microbiology Division. The post is concerned with the susceptibility of potato tubers to bacterial soft rot.

The post, which is financed by a grant from the Potato Marketing Board, is available from 1 August 1977 and subject to annual review, is tenable for 3 years. The post holder will be required to work under the supervision of Dr B. M. Lund.

Candidates should hold a pass degree, HNC or HND, in a biological subject, having undertaken courses giving substantial training in microbiology. Additional experience in plant physiology is an advantage.

The starting salary will be on the Scientific Officer scale of £1149 - £3527 according to qualifications and experience. In addition the following allowances are payable:

- (i) £13/20 per annum;
- (ii) 5% total earnings subject to a minimum of £17/10 per month and a maximum of £17/10 per month.

Application forms and further particulars from the Secretary, Food Research Institute, Colney Lane, Norwich NR4 7UA. Closing date 16 September 1977.

UNIVERSITY OF OXFORD
Inorganic Chemistry
Laboratory

**POST-DOCTORAL
RESEARCH ASSISTANT**

Applications are invited from candidates with relevant experience in chemistry or Materials Science to work in collaboration with Professor J. B. Goodenough and Dr P. G. Dickens on the design, preparation and characterisation of new ionic conductors for use in solid state electrochemical cells.

The appointment would be for two years from 1 October, 1977, on the I.A. Research scale, and with membership of U.S.S.

Applications, giving a curriculum vitae and the names of two referees should be sent to the Administrator, Inorganic Chemistry Laboratory, South Parks Road, Oxford.

**UNIVERSITY OF LONDON
GOLDSMITHS' COLLEGE**

Department of Biological Sciences

Applications are invited for four FULL-TIME DEMONSTRATORSHIPS

in the above department to assist in the teaching of the first year B.Sc. Botany and Zoology courses. Candidates should have a good Honours degree in the appropriate subject and a post-graduate qualification would be an advantage. These posts are tenable from October 1977 and would be for one year in the first instance.

Salary within the range £3315 x 4 increments to £3729 p.a. including London Weighting Allowance and supplements.

Write for further particulars, enclosing a medium size SAE to the Personnel Officer, University of London, Goldsmiths' College, New Cross, London SE14 6NW, to whom applications should be sent by 26 August, 1977.

UNIVERSITY OF LONDON
Institute of Archaeology

Applications are invited for the post of ARCHAEOLOGICAL SCIENTIST

to work in the City of London. Candidates should have a degree in a biological subject, a knowledge of ecology and experience in seed identification. Salary will be on the scale £2912 to £3390 plus £465 p.a. London Allowance. Further details may be obtained from the Registrar of the Institute, 31-34 Gordon Square, London WC1H 9PY, to whom applications should be sent by 3 September, 1977.

Senior Technician

We require a Senior Technician in the Department of Drug Safety Evaluation. A vacancy exists in the Section concerned in general toxicology and reproduction studies. We are looking for candidates with HNC or HND in Applied Biology plus pre and post qualification experience in the field. Possession of a Home Office Licence is essential.

Please apply to:-

Mrs. J. Andrews, Personnel Officer,
Wyeth Laboratories,
Huntercombe Lane South, Taplow,
Nr. Maidenhead, Berks. Tel: Slough 28311.



Wyeth Laboratories

MATERIALS RESEARCH

The Refractories Section of BGIRA requires a graduate or equivalent to study high temperature reactions of refractories with glasses. The work involves laboratory studies of the corrosion of refractory oxides and measurements of the corroding environment in commercial furnaces.

Knowledge of the industry will be acquired in training; experience of the industry is not a requirement for application.

Preferred age 23-32.

Applications should be in writing to:

Mrs M. Peck,
British Glass Industry
Research Association,
Northumberland Road,
Sheffield S10 2UA



The British Glass Industry Research Association
Northumberland Road, Sheffield, S10 2UA.

MRC CLINICAL RESEARCH CENTRE (Northwick Park Hospital) Watford Road, Harrow, Middlesex HA1 3UJ

TECHNICIAN

required in the Division of Communicable Diseases to work on research projects concerned with anti-viral agents and with the study of 'heat' infectious agents. Candidates must hold HNC or equivalent and have experience in micro-biological techniques. A knowledge of diagnostic virology an advantage. Salary within the range £2065-£4092 p.a. Plus pay supplements. Application forms and further details from Mrs J. Tucker-Bull quoting Ref. 106/2/4066. Closing date 26 August.

**LONDON BOROUGH OF
HARINGEY
EDUCATION SERVICE**

**Full-time Senior
Laboratory
Technician**

Required at Somerset School, Whita Hert Lane, Tottenham N17, to work 35 hours per week x 52 weeks per year.

Salary: £4161-15-£4507-56 pa increasing by 2.5% annually according to experience and qualifications.

Applicants must be good organisers and have had previous school experience. Interest in the sciences, also to be considered. Good Visual Aids.

Special qualifications if any:

Higher National Certificate or Higher National Diploma.

City & Guilds Laboratory Technician Advanced Certificate or Dip Tech. University King's Degree or Dip Tech. Association of Institute of Science Technology.

OR an equivalent suitable qualification. OR 10 years' suitable experience.

Application forms obtainable from Child Education Officer, Education Office, Somerset Road, Tottenham N17, returnable by 26th August, 1977.

**NUCLEAR PHYSICS
LABORATORY**

University of Oxford

Applications are invited for an **ELECTRONICS TECHNICIAN (GRADE 3)**

to work in the Track Analysis Group. Here she will assist in the development, manufacture and maintenance of analogue and digital apparatus used in conjunction with computers for data analysis in particle physics. Candidates should possess a basic qualification and be competent in elementary workshops skills. The post in which a bright individual could learn a great deal about modern electronics; day release will be encouraged. Starting salary £2455-£2788 eight weeks leave per year.

Write to Administrator, Nuclear Physics Laboratory, Keble Road, Oxford OX1 3RH mentioning reference A177.

Royal Holloway College
(University of London)
Egham Hill, Egham, Surrey

LASER PLASMA INTERACTION

RESEARCH ASSISTANT required for collaborative project on the Rutherford Laser. Salary range £3333-£4190. Applications, curriculum vitae and the names and addresses of 2 referees to the Personnel Officer, Royal Holloway College, to whom further details may be obtained.

**THE UNIVERSITY
OF LANCASTER**

Applications are invited for the following post:

TECHNICIAN GRADE 6

Required in the Department of Physics. The duties of the person appointed will include overseeing the teaching laboratories, maintaining the departmental equipment and supervising the associated instrumentation.

Salary on the scale £3515-£3850.

Application forms (returnable by 22 August, 1977) available from the Deputy Establishment Officer, University House, Lancaster LA1 4YU.

Medical Research Council

requires

RESEARCH OFFICER

with HNC or a pass degree in physics to include measurements by means of X and Gamma ray spectrometry and to assist in the running and maintenance of a 8 ton Linkson vibracorer.

A recent graduate candidate would be appointed initially in the Technician category but the post will provide opportunities for promotion to Research Scientific staff in the carrying out of investigations and the post holder will, under Research Officer category, where a candidate with at least two years' relevant experience, will be promoted directly to the Research Officer scale.

Initial salary, according to age and experience, ranges from £3354 to £4634, London Weighting and Pay Supplements.

Write with full details to Mrs R. Merchant, Administrative Officer, MRC Geotechnical Research Group, National Hospital, Ducane Road, London W13 0HE, or telephone 01-743 4594, ext 101, for an application form.

ADVISOR

Imperial College Computer Centre requires an Advisor to work in its advisory service. The Centre has two large CDC machines and runs a time-sharing service, soon with 3000 terminals. Users will have access to the University of London's computers through the Metropolitan facility.

Applicants should have a degree in a science subject or computer science, and some experience with programming in Fortran. The work entailed will be to work with the Centre's users to help them use effectively the Centre's machines and some programming activities associated with the service.

Salaries in the range £3354 to £4634 p.a. (inclusive of London allowance).

For further information and application forms please write to: Mr S. Budd, Imperial College Computer Centre, London SW7 2BX.

UNIVERSITY OF DUNDEE**POST-GRADUATE RESEARCH ASSISTANTSHIP IN BIOCHEMISTRY**

This MRC-funded post is available for 3 years at a salary on the scale £2904-£3353 p.a. for research on the control and integration of cholesterol uptake, cholesterol biosynthesis and progestrone formation by suspension of isolated corpus luteum cells.

Honours graduates in Biochemistry or a related subject, who wish to apply should write as soon as possible quoting References Es1/4077H and giving a curriculum vitae and the names of two referees to: The Secretary, The University, Dundee, DD1 4HN. Informal enquiries may be made to Dr A. Stanfield or Dr R. Booth at the Department of Biochemistry at the same address.

ANALYST TECHNICIAN (GRADE 5)

required in Geology Department, University of Reading. Applicants with HNC (Chemistry) or equivalent qualifications/experience preferred. Experience in the detailed analysis of rocks and minerals desirable but not essential. Salary in scale £2885-£3367 p.a. according to qualifications and experience. Further details available from Assistant Bursar (Personnel), University of Reading, Whiteknights, Reading RG6 2AS, to whom applications including full details and names of two referees should be sent.

RIVERS DIVISION**Assistant Engineer/Geologist**

Salary: £4149-£4479 (+ up to £520 p.a. supplement).

Based in Warrington, you will lead a small team of professional and technical staff undertaking special investigations and hydrogeological studies. The areas covered will include assessing aquifer yields, saline intrusion, groundwater quality studies and complex abstraction licence applications.

You should be a chartered civil engineer or a geologist. A post-graduate qualification in hydrology is essential, along with experience of detailed hydrogeological studies. A knowledge of computer programming would be advantageous.

The post carries a regular user car allowance and assistance with re-location expenses will be available in appropriate cases.

Technical Assistant (Hydrometry)

Salary: £3309-£3567 (+ up to £520 p.a. supplement).

Based in Warrington, you will assist in the operation of the hydrometric artwork, particularly with calculations relating to the calibration of river flow measuring stations, and processing field records.

You should be qualified to H.N.C. or equivalent in engineering, mathematics or other scientific subject and have knowledge of flow measuring techniques and rainfall and climatic station requirements. Consideration will be given to lesser qualified candidates with considerable relevant working experience.

Assistance with relocation expenses will be available in appropriate cases.

Assistant Scientific Officer/Biology

Salary: £2850-£3567 (+ up to £520 p.a. supplement).

Based at a biological laboratory at Great Sankey, Warrington, you will be a member of a team investigating biological aspects of water quality, associated with river management problems and fisheries science, involving both field and laboratory studies.

You should be qualified to at least degree level or equivalent in biological science and relevant post-graduate experience would be advantageous.

The post carries a regular user car allowance and assistance with removal expenses will be available in appropriate cases.

Application forms from:

The Personnel Officer, North West Water, Rivers Division, P.O. Box 12, New Town House, Buttermarket Street, Warrington WA1 2QG. (Tel: Warrington 53999).

Closing date for applications: 26 August, 1977.

The above posts are open to men and women.

**UNIVERSITY OF BIRMINGHAM****Department of Social Medicine RESEARCH ASSOCIATE**

A Research Associate is required for analytical work in connection with a two-year survey of levels of caries in teeth in the Birmingham area.

In addition to routine analysis, the successful candidate will undertake limited fieldwork in the four main areas of the city and specimens from local dentists and dental clinics.

The post is suitable for a recent graduate in dentistry or chemistry, who is under the age of 25.

The appointment will be made at a salary in the range of £2904-£3353 per annum+superannuation. Applications including a curriculum vitae and names of two referees should be sent to the Assistant Registrar, Medical School, University of Birmingham B15 2TJ. Closing date: Friday, 26 August, 1977.

SCOTTISH INSTITUTE OF AGRICULTURAL ENGINEERING BASIC CULTIVATION SECTION SCIENTIFIC OFFICER/ HIGHER SCIENTIFIC OFFICER (MATERIALS)

Applications are invited for the post of Scientific Officer/Higher Scientific Officer in a small team investigating some aspects of agricultural basic cultivations and Farm Transport.

QUALIFICATIONS
Appointment in the Grade of Scientific Officer/HSO requires a first honours degree, and preferably a higher degree, or equivalent qualifications and experience in a relevant branch of science or engineering.

SALARY SCALE

Appointment in the Grade of Scientific Officer/HSO is £3354-£4454 according to qualifications and experience.

Assistance with removal expenses are currently payable (£) 312-70 p.a. (II) £312-80 p.a. (III) £312-90 p.a. (IV) £312-80 p.a. There is a non-contributory pension scheme but the Officer is required to contribute 15% of salary to widows pension.

Applications forms and further information from the Secretary, Scottish Institute of Agricultural Engineering, 100 King Street, Edinburgh, EH2 2EP. To whom applications should be submitted by 31st August 1977.

RESEARCH ASSISTANT**(Mechanical and Production Engineering)**

£2376-£2538 p.a.

to work on skin friction measurement and the visualisation in fluid flow using laser interferometry, thickness measurement of thin oil films.

The successful candidate, who should hold a good honours degree in Engineering or Physics, will be expected to register for a higher degree.

Application forms and further details may be obtained from the Personnel Officer, Brighton Polytechnic, Moulsecoomb, Brighton, BN2 4GJ.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY**WATER CHEMIST**

Postdoctoral Research Assistant to join team working on trace elements in water chemistry. Salary according to age and experience up to £4254, including London allowance, plus superannuation. Applications to: Dr J. Thornton, Applied Geochemistry Research Group, Geology Department, Imperial College, London SW7 2BP.

BUILDING MATERIALS DEVELOPMENT

An exciting opportunity now exists for a young development technologist with HNC or equivalent qualifications to join a progressive company engaged in the manufacture of building materials. In return for a high level of responsibility, the successful applicant will be expected to assume a large measure of responsibility for organising own work programme, developing new products, research and testing techniques in the laboratory. Some experience in concrete technology, clay products or calcium silicate materials is desirable but not essential. A competitive salary will be offered.

Apply in writing to: Technical Director, Sevenoaks Brick Works Ltd., Great Sevenoaks, Kent.

UNIVERSITY OF YORK**Department of Chemistry**

Applications are invited for a **RESEARCH TECHNICIAN** to assist in research of staff in studies in organic chemistry. The work is concerned with novel investigations in reaction mechanism and particularly suitable for students. Salary on Grade 3 (£2455-£2788 p.a.).

Further details and application form from: Department of Chemistry, University of York, Heslington, York YO1 5DD. Closing date for completed application forms, 2 September, 1977.

QUEEN ELIZABETH COLLEGE**(University of London)****Biochemistry Department****TECHNICIAN GRADE 6**

An experienced technician is required to supervise teaching laboratories. Experience in teaching laboratories is desirable. Salary on scale from £3337-£3970 p.a. (depending on qualifications and experience) plus London weighting of £665 p.a.

Applications, giving experience, age, etc, to the College Secretary, Queen Elizabeth College, Campden Hill Road, London W8 1AH.

INTERMEDIATE TECHNOLOGY DEVELOPMENT GROUP wishes to appoint a **SENIOR AGRICULTURAL ENGINEER** to its Agriculture and Water Unit at the National College of Agricultural Engineering, Stevenage. The appointment will be permanent and pensionable in the salary range: £3323-£6553 p.a.

The successful candidate will have a relevant degree, be in mid-career and have experience of developing countries. He must be a good organizer and communicator. Although the post will be based, it will be required to travel overseas. Full details obtainable from ITDG Ltd., 9 King Street, London, WC2E 8HN.

TECHNICIAN AND A JUNIOR TECHNICIAN

Vacancies exist in Tissue Culture and Cytogenetics Laboratory. Experience in an allied field an advantage. Applications invited for part-time and day release where appropriate for the Junior Technician post. Applications to be sent to the Admissions Officer, Assistant Director, Research Unit, The Prince Philip Research Laboratories, Guy's Tower, London Bridge, SE1 9RT.

STUDENTSHPHS

ROTHAMSTED EXPERIMENTAL STATION HARPENDEN, HERTS.
ALS 3JG

PHYSICS FOR FARMING

ARC Research Studentship from October 1977

Applications are invited from graduates or honours graduates in Physics for an ARC Research Studentship to study some aspects of soil water physics and their applications to the movement and availability of water in the soil profile. A first or upper-second class honours degree or an equivalent qualification is required. The successful candidate will be registered with a University for a PhD.

Applications, with curriculum vitae and the names of two referees, should be sent as soon as possible to the Head, Physics Department, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER

SiMON ENGINEERING LABORATORIES

SiRC CASE AWARDS

Applications are invited from eligible candidates for three three-year SiRC CASE studentships, available in the Mechanical Engineering Department. Candidates must be honours graduates in Engineering, Mathematics and should be particularly interested in the measurement of turbulent flow properties and the analysis of random signals.

(i) AERODYNAMIC PERFORMANCE OF SHORT CYLINDRICAL STRUTS (Offered in collaboration with Rolls-Royce) (1977-80).

(ii) THE ASSESSMENT OF TURBULENT FLOW DATA (Offered in collaboration with the British Gas Council).

Application forms and further information may be obtained from the Post-graduate Admissions Tutor, Simon Engineering Laboratories, The University, Manchester, M13 9PL.

New Scientist is printed in Great Britain by Index Printers, Oldhill, London Road, Dunstable, Beds, and Thomas Jenkins (Printers) Ltd, 108 Weston Street, London SE1 and published by IPC Magazines Ltd, King's Reach Tower, Stamford Street, London SE1 9LS. Sole Agents for Australia and New Zealand, Government Agents (Australasia) Ltd, Wellington, New Zealand. Conditions of sale: this periodical shall not, without the written consent of the publishers, be sold, lent, resold, hired, lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

UNIVERSITY OF DURHAM
Department of Chemistry
SRC CASE RESEARCH STUDENTSHIP

Applications are invited for a CASE PhD Studentship; the research topic being the ECA investigation of the mechanism and mechanism of the weathering of polymers (under the supervision of Dr T. Clark). This would involve fundamental scientific investigations of an area of considerable academic and industrial importance and will involve close collaboration with a well established research group led by Dr A. Davis, Ministry of Defence, Propellants, Explosives and Rocket Research Establishment, Waltham Abbey. Candidates should have at least an Upper Second Class Honours Degree, in either Chemistry or Materials Science, or Grad RIC.

Applications, together with the names of two referees should be sent by 1 September 1977 to Dr D. J. Clark, Department of Chemistry, Science Laboratories, South Road, Durham DH1 3LE.

STUDENTSHPHS

UNIVERSITY OF READING
Department of Chemistry
TWO POSTGRADUATE STUDENTSHPHS

Applications are invited for work on the preparation and characterisation of heterogeneous catalysts under the supervision of Dr R. Burch and Dr P. H. Mitchell. There is a fully sponsored studentship open to anyone with a first or second class honours degree and an SRC CASE studentship. Starting date will be 1 October, 1977 (or later by arrangement). For further details apply immediately to Dr P. H. Mitchell, Department of Chemistry, Whiteknights, Reading RG6 2AD. (Ref. MS35A).

FELLOWSHIPS, GRANTS, SCHOLARSHIPS

Readvertisement

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Civil Engineering

RIDLEY FELLOWSHIP IN AIR AND WATER POLLUTION

Applications are invited from persons who have shown themselves to be capable of original research in the Ridley Fellowship tenable in the Public Health Engineering Division of the Civil Engineering Department. The Fellowship is financed by the British Steel Corporation to promote research on aspects of air and water pollution. Applicants should normally have a higher degree (preferably PhD) in a relevant branch of Science or Engineering.

The normal tenure of the Fellowship will be three years from 1 October 1977 (or such other date as may be agreed). The stipend for the first year of the Fellowship will be £3333, for the second year £3447 and for the third £3561.

Further particulars and application forms (which must be returned by 31 August, 1977) may be obtained from the Registrar, University of Newcastle upon Tyne, 6 Kensington Terrace, Newcastle upon Tyne NE1 7RU.

New Scientist is printed in Great Britain by Index Printers, Oldhill, London Road, Dunstable, Beds, and Thomas Jenkins (Printers) Ltd, 108 Weston Street, London SE1 and published by IPC Magazines Ltd, King's Reach Tower, Stamford Street, London SE1 9LS. Sole Agents for Australia and New Zealand, Government Agents (Australasia) Ltd, Wellington, New Zealand. Conditions of sale: this periodical shall not, without the written consent of the publishers, be sold, lent, resold, hired, lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

UNIVERSITY OF SOUTHAMPTON

Department of Chemistry POSTDOCTORAL FELLOWSHIP IN SYNTHETIC ORGANIC CHEMISTRY

A Research Fellowship is available from October, 1977 at a salary of up to £5450 per annum, renewable for a second year at £5761 plus superannuation, for development of research projects in synthetic organic chemistry naming two referees, should be sent as soon as possible to Professor R. C. Cookson, Department of Chemistry, University of Southampton, SO9 2SN. Please quote reference MA1/2/294/NS.

SERVICES

TYPING

Are you tired of errors made by typists who are not familiar with medical terms? Now a graduate biologist will type for you (especially biological and chemical material). Save time and money. For further details contact Mrs Margaret Brumpton, 10 Ashvale, Cambridge CB4 2SZ. Tel: Cambridge 61388.

LECTURES, MEETINGS & COURSES

UNIVERSITY OF LANCASTER

GEOPHYSICAL SCIENCES

This course leads to an honours BSc degree and is taught jointly by the departments of Physics and Environmental Sciences. It is intended for students interested in courses in the application of physics to environmental problems. As well as providing an introduction to the subject, the topics, such as geophysics, meteorology, hydrology and general planetology, the course serves as a general training in classical applied physics.

The entry requirements are at least one of Physics, Physical Science or Engineering Science together with Mathematics at "A" level.

Further details may be obtained from the Course Director, Professor A. N. Hunter, Department of Environmental Sciences.

THE CITY UNIVERSITY

Department of Chemistry

A course of lectures on "THE ASSESSMENT OF MAJOR CHEMICAL HAZARDS"

will be given by
Professor J. H. Burgoyne
and Mr V. J. Clancy
from 7 to 9 November 1977.

Further details from the Secretary, Chemistry Department,

The City University, St. John Street, London EC1V 4PB.



THE PRESENT AND FUTURE OF CANCER RESEARCH

A lecture will be given on Thursday 29 September at 8 p.m. at the Royal Institution, 21 Albemarle Street, W1 by Prof. Leo Sachs, Dean of the Faculty of Biology of the Weizmann Institute.

Prof. Sachs received his PhD degree from Cambridge University in 1951, joined the scientific staff of the Weizmann Institute of Science at Rehovot, Israel in 1952 and has since been working on various aspects of cancer research. He is now the Otto Meyerhof Professor of Biology, Head of the Department of Genetics and Director of the Biology Institute.

In his lecture he will discuss the present state of the biological and clinical aspects of cancer research and potential new developments.

The present main approaches to cancer therapy are surgery, chemotherapy and radiotherapy. Studies on the regulation of normal and malignant cell growth and differentiation have shown that it is possible to induce experimentally some malignant cells to again behave like normal cells. The reversal of malignant cells is a possible new approach to cancer therapy. It may also help to explain why the present forms of therapy are not always successful.

Admission by ticket only available from The Weizmann Institute Foundation, 11 Rodmarn Street, London W1N 3JT. Telephone: 01-486 3954. Members of the Royal Institution can obtain tickets from the Royal Institution.

MAGAZINE SECRETARY

We are looking for a secretary shorthand-typist for the Managing Editor and Art Editor of New Scientist.

This is an interesting job in a pleasant, friendly, open plan air-conditioned office. Staff canteen. Hours 10-4.50, £51-90. week. Applicants should be 21+. If you would like more details, please telephone Pat O'Flanagan, 01-485 6029, or write to her at: Room 2637, IPC Magazines Ltd, King's Reach Tower, Stamford Street, London SE1 9LS.

HOLIDAYS

ATHENS FROM £25

by coach also Paris, Geneva, Italy, Istanbul, Israel, Egypt. Coach/boat. Tel: 01-485 6078.

Ariadne

■ One of the depressing after effects of colonialism in Africa is the dependence on imported food among some of the coastal peoples. Iran, it seems is about to embark on this daft course. Lack of rainfall (11in a year) is the cause of the trouble. Only 13 per cent of the country is arable; indeed only 4 per cent is under cultivation although 40 per cent of the work force is involved. The *Christian Science Monitor Weekly* (1 August) reports that some of the oil money is to be spent on imported packaged foods and a US delegation has already been along to show its wares. One of the difficulties (and customer acceptance is, apparently, not one of them) is the shortage of electricity to power the deep freezers—the cities have almost daily blackouts—but doubtless the oil revenues will take care of that, too. What baffles me is the decision of the authorities to buy foreign food instead of putting the money into agriculture, so that when the oil runs out, starvation won't be the first problem they have to face. Meanwhile, I hope the peasants enjoy their frozen TV dinners.

■ The British physicists, I see, are in a state of advanced disenchantment with the way the Soviet apparatchiks strangle the free flow of scientific information. The tragedy is that, by all accounts, apart from the ideological pedants in the upper reaches, Soviet scientists get on well with their Western colleagues and there is mutual respect. The likeability of the Russians, in fact, survives the granitic ponderousness of their government. Hedrik Smith in his *The Russians* (Sphere £1.50) tells a delightful story of a young US diplomat on his first saunter around Moscow, discovering he was being tailed. He went up to an icecream seller in Red Square and bought two lollies and without turning round, held out one behind his back. "The shadow took it without a word".

■ A friend told me this story which he says he had from someone who knew. A school party was taken to London Zoo for an end of term outing. All the kids behaved well except one who continually poked fingers where they were forbidden, made faces at the dangerous animals and generally made a nuisance of himself. Finally he was packed off back to the coach to eat his sandwiches and wait while the rest of the party finished the round tour. That night he arrived home saying nothing and clutching the duffle bag in which he had carried his packed lunch. "I'm tired and want to go straight to bed", he told his parents for the first time in his life. Normally bedtime is a family fight, with the child frogmarched up the stairs. Smelling trouble, the parents gave him five minutes to get settled and then went through to his room. There on the floor, next to an empty duffle bag, was a healthy sized penguin eating the remains of packed lunch from the child's hand.

■ My pornostructural friend Daedalus regrets that inflatable buildings, rafts, etc, are still relatively floppy even when pumped up. By contrast that popular biological inflatable, the penis, has far superior characteristics and achieves admirable stiffness with only about one-fifth of an atmosphere of blood pressure. It does this by using hydraulic rather than pneumatic pressure, and by exploiting a network of many tiny capillary fluid spaces rather than a single large sac. So DREADCO chemists are producing open-cell foamed polymer systems whose internal cavity-structure mirrors as closely as possible that of human erectile tissue. Moulded-in hydraulic connections enable this floppy stuff to be pumped up rigid with hundreds of atmospheres of hydraulic pressure, giving it a stiffness comparable with that of many engineering materials. Daedalus expects it to revolutionise structural engineering. All sorts of ordinary objects: chairs, tables, cisterns, cases etc, could be moulded from the new material, transported as floppy tangles, and pumped up to superb rigidity as desired.

Similarly DREADCO's erectile trousers could retain admirable flexibility for walking about, but could be locked rigid by an inconspicuous pump in one of the pockets whenever the wearer wished for standing support. And erectile motor-cars would need no suspension-system. Their body-flexibility could be varied automatically by changes in hydraulic pressure to damp out whatever road-vibration they encountered from moment to moment. And in a serious crash, rupture of their hydraulic lines would instantly collapse them safely to floppy cushioning masses. On an even larger scale, the DREADCO erectile office-block could be assembled on-site from easily transported flabby units, and pumped up in a few minutes. New units could be quickly stiffened in place if expansion was contemplated. In earthquake regions it could be automatically slackened to a resilient degree of droop when warning tremors began, or collapsed slowly to let workers on the upper floors escape. And it could be detumescent overnight in response to changes in urban planning policy.



Digital Timepiece. Alarm Clock. Stopwatch. Calculator.

The four-in-one **CASIO**

COMPUTER QUARTZ

is all of them!



The CQ-1 measures just 5 $\frac{5}{8}$ "x 2 $\frac{1}{2}$ "x 1 $\frac{1}{8}$ "
Recommended price £35.95 inc. VAT.

Ryman price £29.95 inc. VAT.

For further details of calculators and other business machines
telephone 01-405 9333
American Express, Diners, Access, Barclaycard welcome.



Ryman

IF YOU ARE HAVING DIFFICULTY IN RECRUITING AN

Animal Technician, Analytical Chemist, Biologist, Biochemical Entomologist, Computing Scientist, Catalytic Studies Chemist, Clinical Research Associate, Computer Programmer, Digestive Physiologist, Electronics Technician Experimental Officer (Anaesthetics/ Analgesics), Electron Microscopist, Forensic Scientist, Fisheries Scientist, Food and Nutrition Programme Officer, Glassblower, Hydrologist, Hydrogeologist, Insect Biologist, Industrial Chemist, Language Laboratory Technician, Metals Technologist, Medical Information Scientist, Microbiologist, Neurophysiologist, Nutrition Lecturer, Organic Chemist, Pharmacist, Physicist, Physics Technician, Pulmonary Function Technician, Research Biochemist, Reference Librarian, Research Manager, Registration Manager, Research Demonstrator, Section Head - Mutagenicity Research, Soil Scientist, Tissue Culture Technician, Technical Sales Co-ordinator, Technical Representative, or Water Quality Biologist.

newscientist

the most cost effective weekly
news magazine of science
and technology
can solve your problem.
28,000* Engineers, Scientists
and Technologists can be
reached at £6.30 per s.c.c.

* source : Businessman Readership Survey 1977